Aviation Week and Space Technology

November 27, 1961

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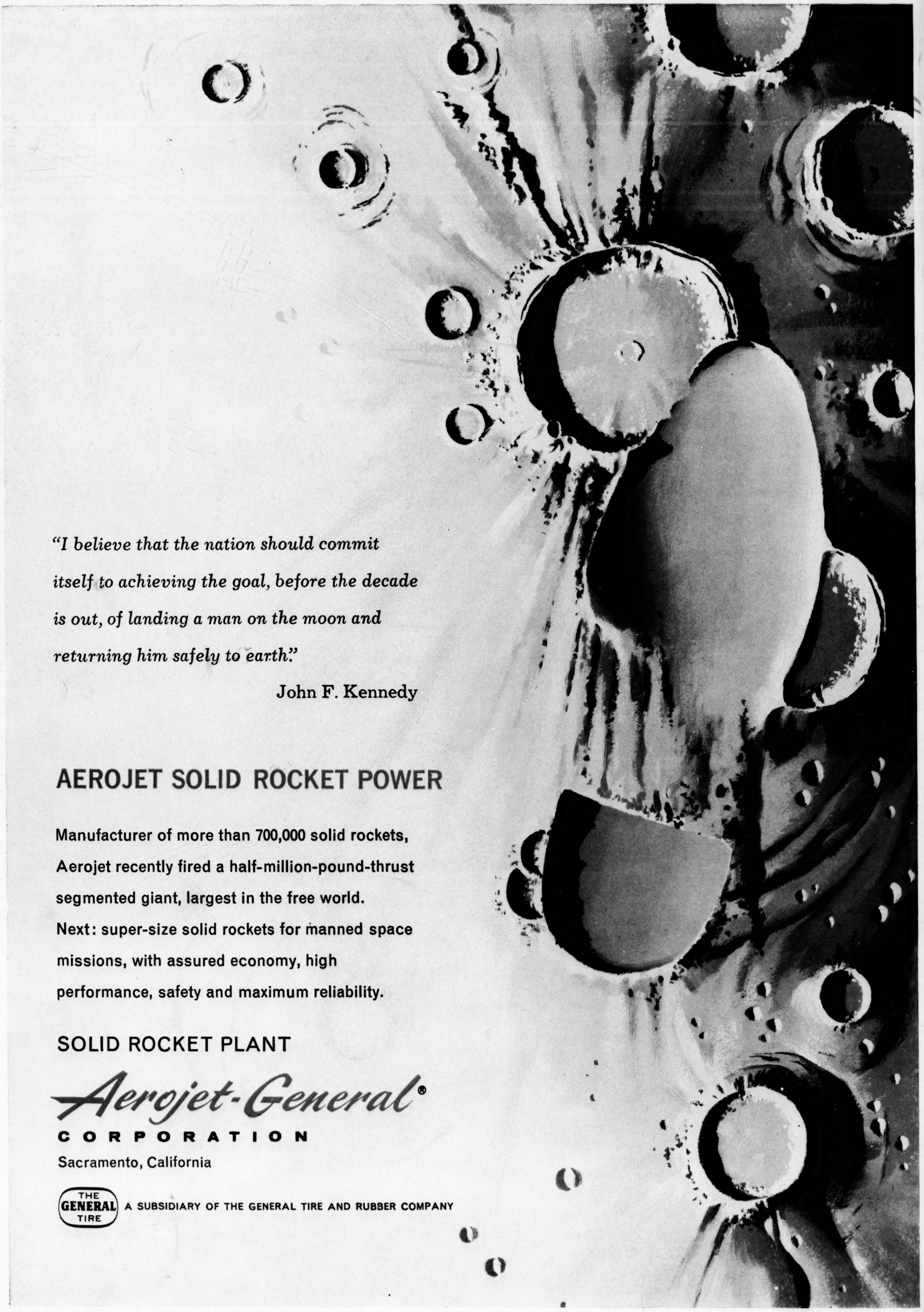

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## AEROSPACE CALENDAR

**Dec. 4-5**—Beryllium Metallurgy Conference, New York University's Washington Square Center, New York, N. Y.

**Dec. 4-6**—Specialists' Meeting on Aerospace Support and Operations (classified), Institute of the Aerospace Sciences, Orlando, Fla.

**Dec. 5-7**—11th Annual Meeting, National Air Taxi Conference, Statler-Hilton Hotel, Washington, D. C.

**Dec. 5-7**—Annual Convention, National Aviation Trades Assn., Statler Hilton Hotel, Washington, D. C.

**Dec. 7**—Panel Discussion "Our Investment in Outer Space," American Society of Mechanical Engineers, Kresge Auditorium, MIT, Cambridge, Mass.

**Dec. 12-14**—Eastern Joint Computer Conference, Sheraton Park Hotel, Washington, D. C.

**Dec. 18**—25th Wright Brothers Lecture, Natural History Bldg., Smithsonian Institution, Washington, D. C.

**Jan. 8-12**—1962 Automotive Engineering Congress and Exposition, Society of Automotive Engineers, Cobo Hall, Detroit.

**Jan. 9-11**—Eighth National Symposium on Reliability and Quality Control, Statler Hilton Hotel, Washington, D. C.

**Jan. 15-17**—Symposium on Optical Character Recognition, Department of the Interior Auditorium, Washington, D. C. Sponsored by Information Systems Branch/Office of Naval Research and Research Information Center/National Bureau of Standards.

(*Continued on page 6*)

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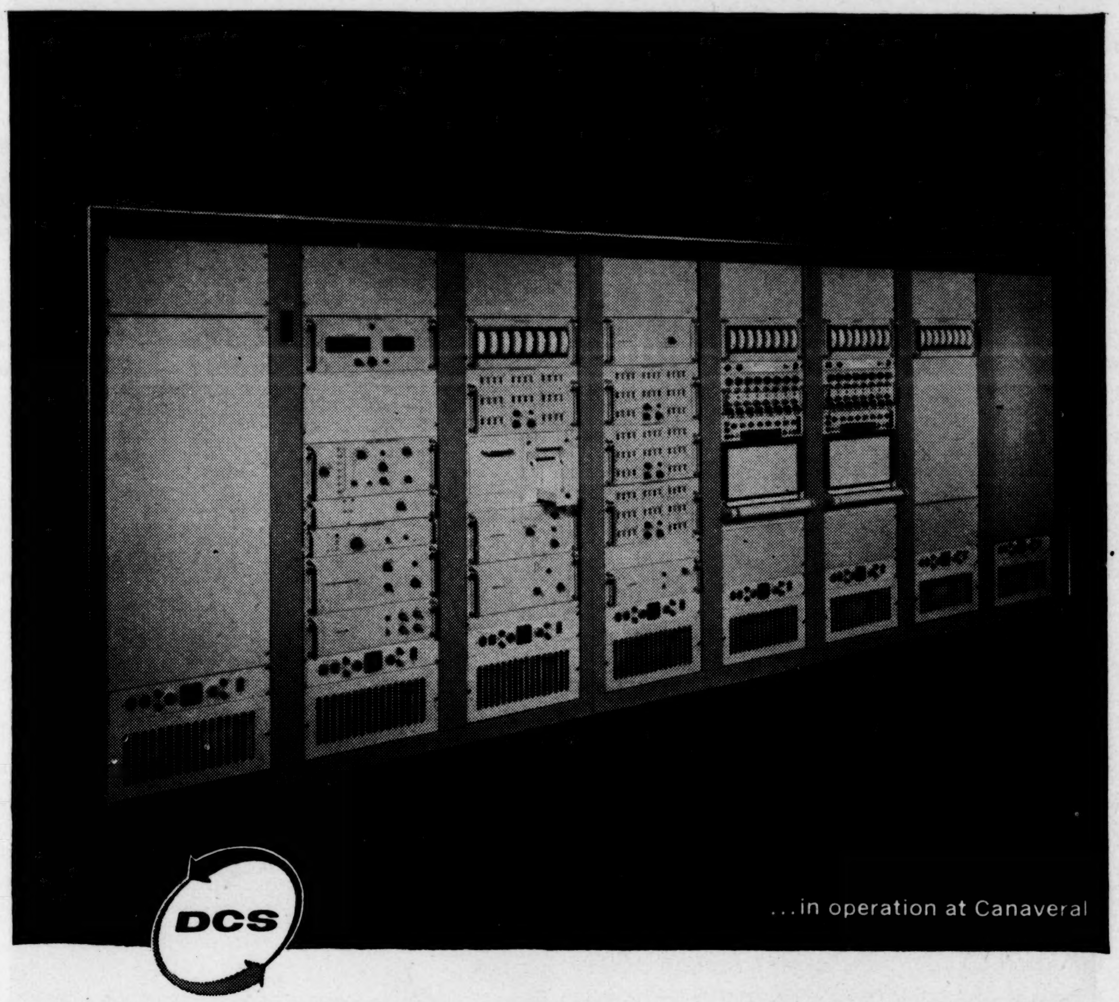

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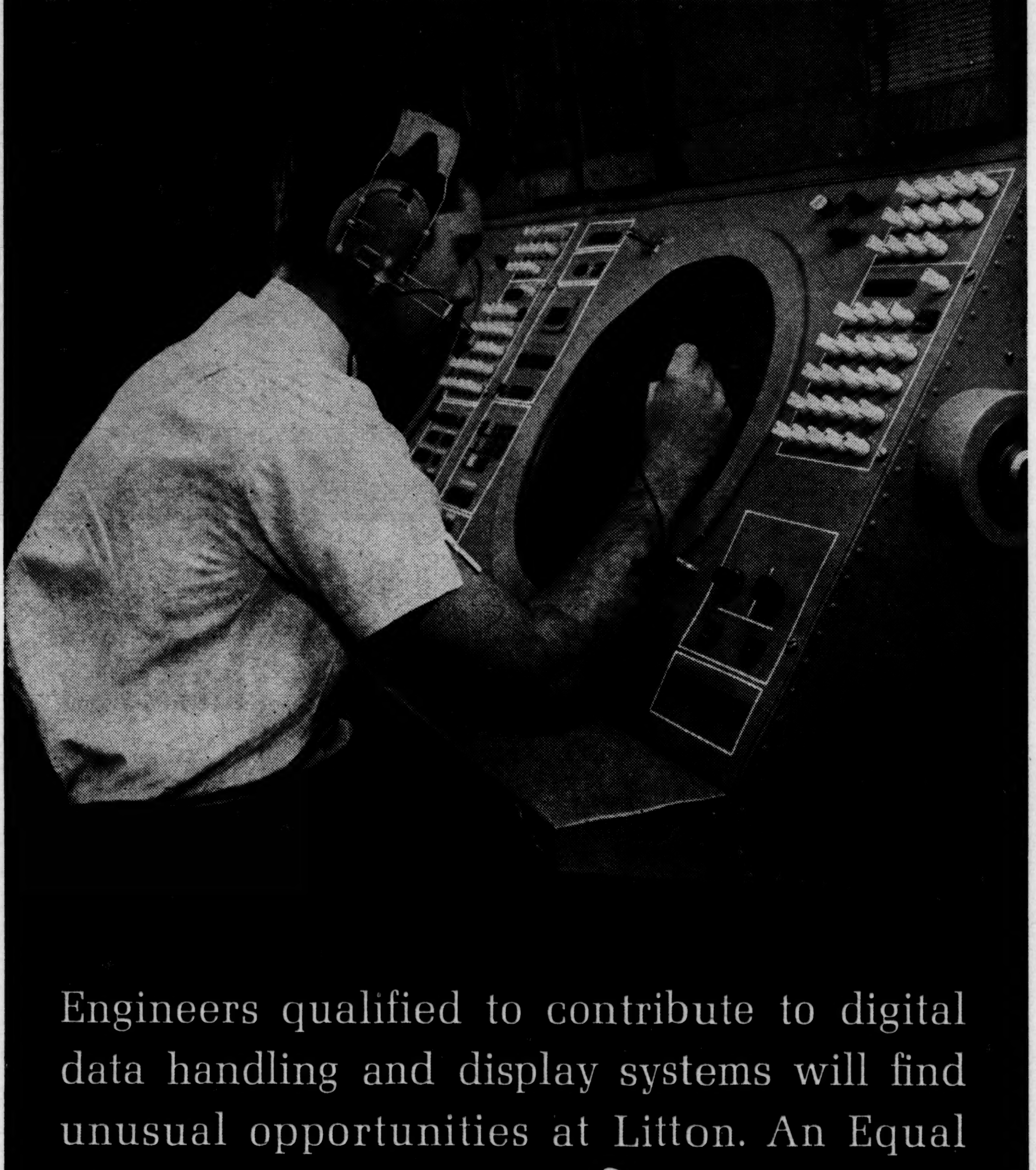

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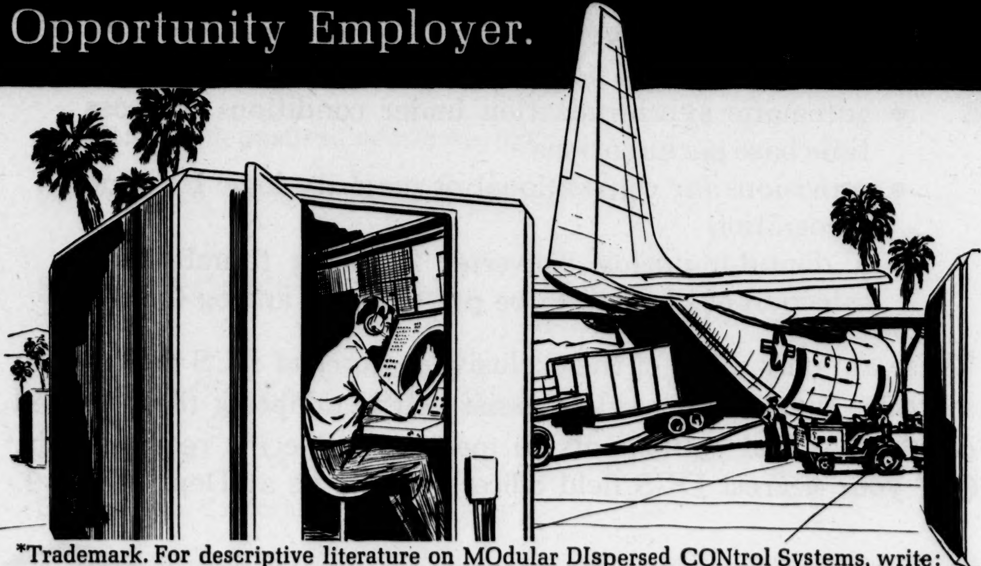

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## AEROSPACE CALENDAR

*(Continued from page 5)*

**Jan.** 21-24—Annual Meeting, Helicopter Assn. of America, Marriott Motor Hotel, Dallas, Tex.

**Jan.** 22-24—30th Annual Meeting, Institute of the Aerospace Sciences, Hotel Astor, New York, N. Y. Honors Night Dinner, Jan. 23.

**Jan.** 23-26—Third Annual Solid Propellant Rocket Conference, American Rocket Society, Baylor University, Waco, Tex.

**Jan.** 24-26—Second Symposium on Thermophysical Properties, Princeton, N. J. Sponsor: Heat Transfer Division, American Society of Mechanical Engineers.

**Feb.** 6-7—Symposium on Redundancy Techniques for Computing Systems, Department of the Interior Auditorium, Washington, D. C. Sponsor: Information Systems Branch, Office of Naval Research.

**Feb.** 7-9—Third Winter Convention on Military Electronics, IRE, Ambassador Hotel, Los Angeles.

**Feb.** 14-16—International Solid-State Circuits Conference, Institute of Radio Engineers, Sheraton Hotel and University of Pennsylvania, Philadelphia, Pa.

**Feb.** 19-21—Range Reconnaissance and Tracking of Aerospace Vehicles, Institute of the Aerospace Sciences, San Francisco, Calif.

**Feb.** 27-Mar. 1—Third Annual Symposium on Nondestructive Testing of Aircraft and Missile Components (unclassified), Gunter Hotel, San Antonio, Tex. Sponsors: South Texas Section-Society for Nondestructive Testing; Southwest Research Institute.

**Feb.** 27-Mar. 1—Symposium on the Application of Switching Theory in Space Technology, Palo Alto, Calif. Sponsors: Lockheed Aircraft Corp.; Air Force Office of Scientific Research.

**Mar.** 1-3—Eighth Scintillation and Semiconductor Counter Symposium, IRE, Shoreham Hotel, Washington, D. C.

**Mar.** 5-8—Seventh Annual Gas Turbine Conference and Products Show, American Society of Mechanical Engineers, Shamrock Hilton Hotel, Houston, Tex.

**Mar.** 8-9—Institute of the Aerospace Sciences' Flight Propulsion Meeting (classified), Cleveland, Ohio.

**Mar.** 14-16—Electric Propulsion Conference, American Rocket Society, Hotel Claremont, Berkeley, Calif.

**Mar.** 26-29—International Convention, Institute of Radio Engineers, Coliseum and Waldorf Astoria, New York.

**Mar.** 28-29—Third Symposium on Engineering Aspects of Magnetohydrodynamics, University of Rochester, Rochester, N. Y. Sponsors: American Institute of Electrical Engineers; Institute of the Aerospace Sciences; Institute of Radio Engineers; University of Rochester.

**Apr.** 1-4—Mid-Year Conference, Airport Operators Council, Shoreham Hotel, Washington, D. C.

**Apr.** 3-5—Launch Vehicles: Structures and Materials Conference, American Rocket Society, Ramada Inn, Phoenix, Ariz.

**Apr.** 3-6—National Aeronautic Meeting (including production forum), Society of Automotive Engineers, Hotel Commodore, New York, N. Y.

November 27, 1961

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## and Space Technology

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**COVER:** NATO's Breguet 1150 ASW Atlantic is shown landing at Toulouse, France. Atlantic is a NATO-sponsored development program. Main U. S. contribution is electronics. Breguet is over-all manager of the program; Sud Aviation supplies the outer wings; SABCA and Fairey Aviation in Belgium—in a firm called ABAP—handle the installation of the aircraft's two Rolls-Royce Tyne turboprops; Holland's Fokker supplies center section and nacelles and West Germany's Dornier is responsible for rear fuselage, tail. (See pp. 52-53 for other details and photos.)

**PICTURE CREDITS**

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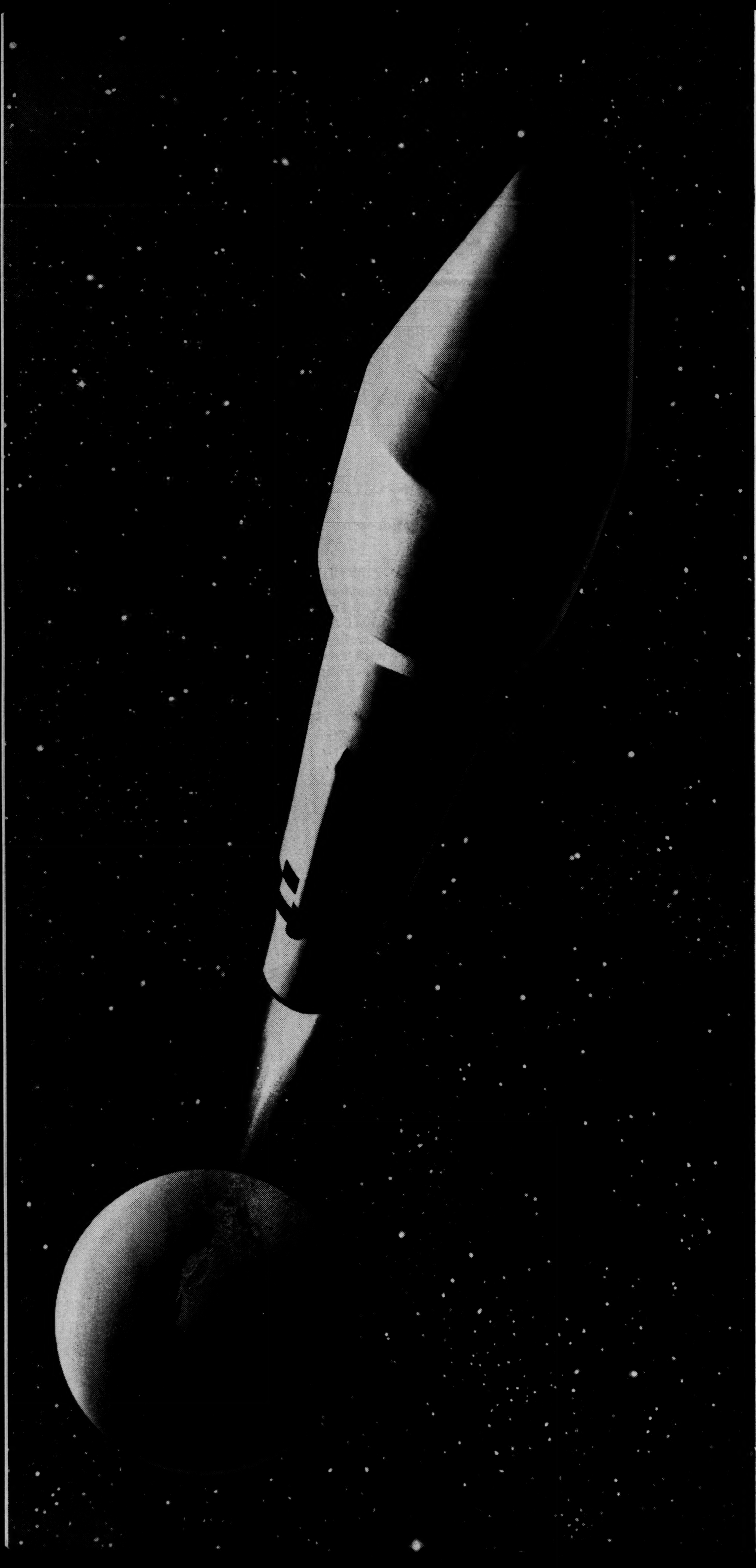

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# EDITORIAL

## Supersonic Transport Progress

It appears that the supersonic transport now is slowly moving out of the talking stage into a period where some firm decisions on its development are being made and some dollars, francs and pounds sterling are being mustered to support it. All of this is transpiring despite the testy outburst against supersonic transport development by Sir William Hildred at the International Air Transport Assn. annual meeting in Sydney, Australia last month. It appears that this gratuitous advice, tendered annually to the air transport industry by Sir William, will be ignored both in the technical area of the supersonic transport and in the economic area of fare structures.

In the United States, $11 million will soon be channeled into industry to begin the task of filling the key gaps in the current state of the art necessary for the development of an economically feasible Mach 3 transport (AW Nov. 6, p. 40). This effort also has been bolstered by two other recent actions:

- **USAF-Federal Aviation Agency management agreement** that utilizes the extensive technical management resources of the Aeronautical Systems Division of the Air Force Systems Command at Wright-Patterson AFB, headed by Maj. Gen. Austin Davis.
- **Creation of a special aeronautical research division** headed by John Stack in National Aeronautics and Space Administration headquarters with the supersonic transport program as a major part of its effort.

### European Cooperative Effort

In Europe the shape of the supersonic transport effort is becoming clearer with confirmation of the British Aircraft Corp.-Sud Aviation agreement (AW Nov. 6, p. 40) for a cooperative effort on a Mach 2.2 transport. Whether this agreement will be expanded further into the European consortium envisioned by Sud Aviation president, Georges Hereil, in his Albert Plesman Memorial lecture (AW Oct. 2, p. 43) is not yet clear. But it is certainly still a definite possibility.

The third entry in the supersonic sweepstakes is, of course, the Soviet Union where about all that is known of their effort is that it is definitely under way and apparently involves a basic new design rather than cobbling up an existing military design. Since the supersonic transport will depend extensively on international operations for its ultimate success, we wonder how much effort the Soviets are devoting to bringing this design up to the standards of international airline operations after their failures to do so with their current jet and turboprop transport stable. It must have been a bitter disappointment for the Soviets to see their once-promising export drive with the Il-18, An-10 and Mil helicopters fizzle so fast and find that even Soviet satellites such as the Poles and Yugoslavs prefer British and U.S. transports. The purchase of British Viscounts and VC-10s by the Chinese is a resounding diplomatic slap at the Soviet aircraft designers as well as an oriental recognition of technical realities.

Another portion of Georges Hereil's plan for Western supersonic transport development seems destined to occur even if the formal agreement he recommended is never attained. This is the division of the market between a European Mach 2.2 version, available in the 1968-70 period and basically a 2,000-2,500 mi. range aircraft, and the U. S. Mach 3-plus transport, probably not available before 1972-75 and definitely a long-range transoceanic machine.

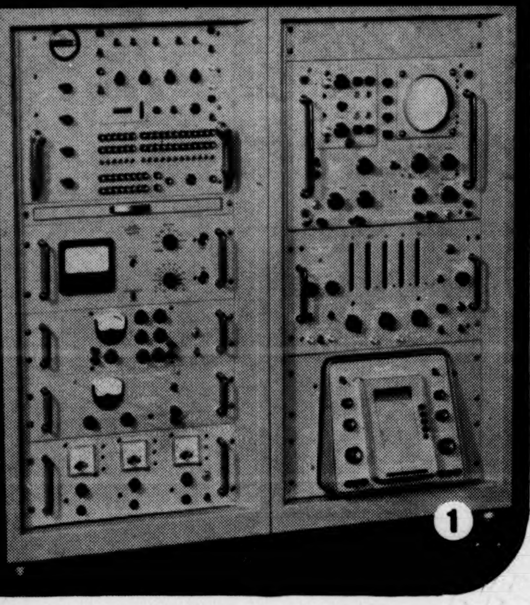
### Difference of Opinion

The British have been apprehensive over tackling anything beyond the Mach 2 range, while in this country we have been equally determined that the game is not worth the candle unless the end result will be in the Mach 3-plus speed range. There is no doubt that the technical fears raised by the British over Mach 3 have some grounds and represent genuine problems that must be solved. However, it may well be that the lack of British flight experience in the speed ranges beyond Mach 2 has led to their magnification of these problems into unsurmountable obstacles in the manner that the so-called "sonic wall" was bugabooed in the mid-forties before anybody had any real experience with its phenomena. The British just now are readying their Bristol T.188 research aircraft to explore the flight ranges from Mach 2 onward, and with an engine refit eventually hope to reach Mach 3 with this aircraft. In contrast, the North American X-15 has been providing a steady flow of flight data up to Mach 6 and temperatures to 1,100F while operational flight experience over Mach 2 has been logged extensively by USAF and Navy fighters and bombers in service.

There are certainly formidable technical obstacles that must still be surmounted to produce an economically sound Mach 3-plus transport and the U. S. effort is now wisely concentrated on research in these key problem areas. It may well be as Georges Hereil suggests, that there will be ample room for both in the supersonic transport market. At any rate we think the present U. S. development course is sound. Although it may prove more expensive and take longer than the current scheduled projects, we predict the ultimate goal will be reached successfully.

We also predict that, despite the dire prophecies of doom by Sir William Hildred and his ilk, the supersonic transport will arrive on the international airline scene and when it does will prove beneficial to both the operators and the people of the world who are their customers.

**—Robert Hotz**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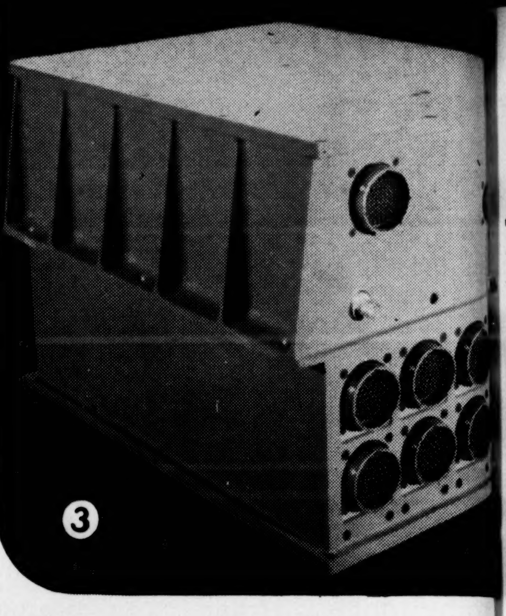
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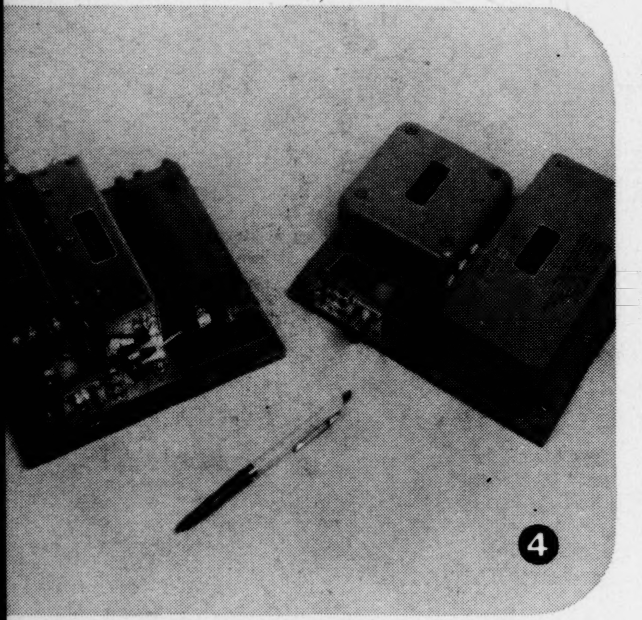
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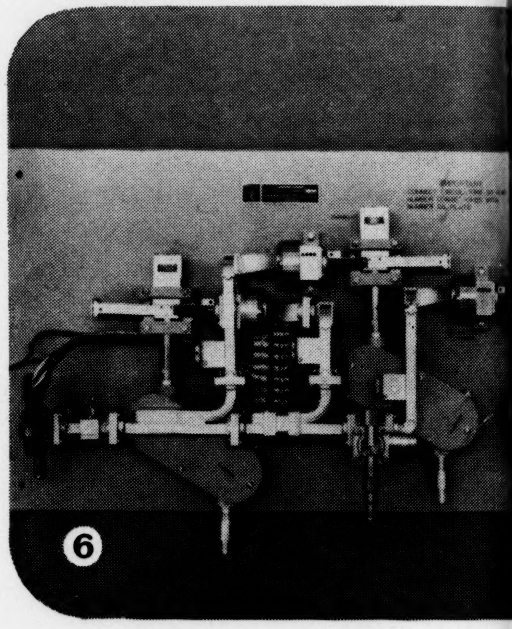
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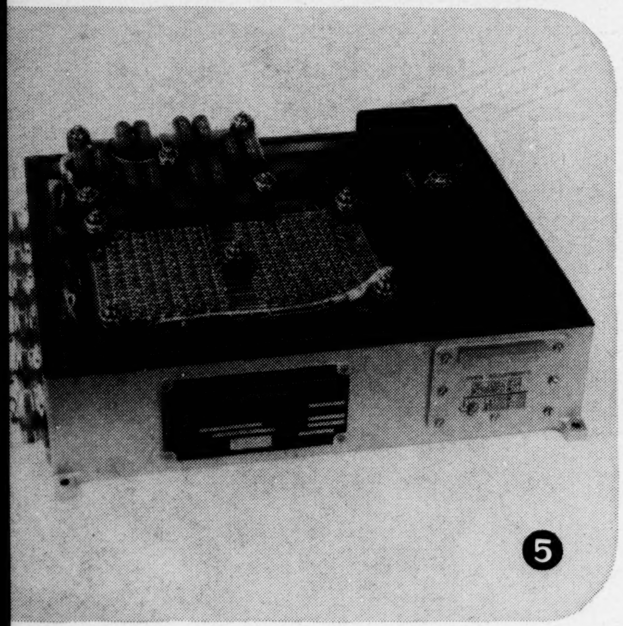
2. Solid-State FM/FM Telemetry Transmitters operated in Mercury spacecraft flights.
3. Flight Data Encoder uses high/low-level PCM telemetry system . . . with ±0.5% accuracy, nulled-out drift. A similar 70-channel system has been supplied to Jet Propulsion Laboratory for Mariner A.
4. Solid-State UHF Beacon Transponder made possible missile tracking by MIT Lincoln Laboratories Millstone radar.
5. Digital flight controller/programmer in Douglas Aircraft's Delta Launch vehicle helped orbit NASA weather satellites Tiros II and III, communication satellite Echo I, space probes Explorer X and XII.
6. 3-Channel Parametric Amplifier—Low-noise operation for C-Band monopulse satellite tracker for Bell Telephone Laboratories.
7. Digital Command Decoder for Ranger 3-5 lunar probes.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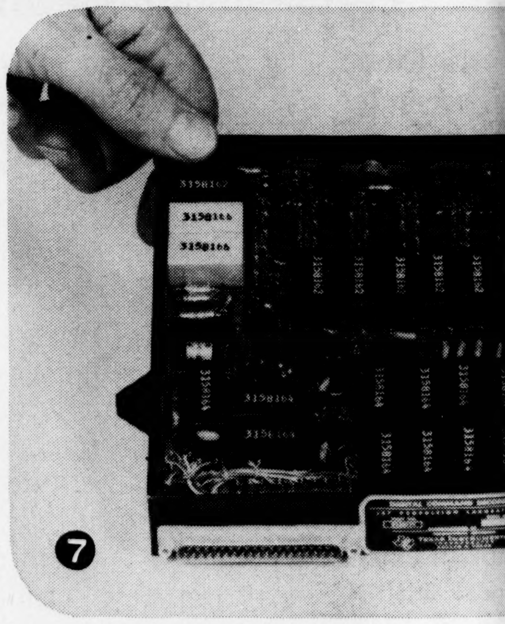
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**L. D. Rexroat**, president and board chairman, U. S. Science Corp., Los Angeles, Calif., a division of United Industrial Corp.

**Dr. Harry K. Waldes**, board chairman, Waldes Kohinoor, Inc., Long Island City, N. Y., and **George Waldes**, president. Dr. Harry Waldes continues as executive vice president of the company.

**Earl L. Schoenlein**, vice president-sales, Thompson Industries division of Space Equipment Corp., Los Angeles, Calif.

**C. L. Fenn**, vice president-manufacturing, and Gerald Albert, vice president-engineering, Edo Corp., College Point, N. Y. **Paul J. Weinstein** succeeds Mr. Albert as Edo's chief engineer-electronics.

**Merlon F. Richards**, vice president of Dynalectron Corp., Washington, D. C., elected a director, succeeding **W. W. Brinckerhoff**, resigned.

**Dr. S. Dean Wanlass**, president, Packard Bell Computer Corp., Los Angeles, Calif. Dr. Wanlass continues as group vice president, Defense and Industrial Group, Packard Bell Electronics Corp. Named vice presidents of Packard Bell Computer are: **Kenneth R. Jackson** for administration; **William Seiden** for manufacturing; **Theodore J. Smith** for marketing.

**A. V. Gangnes**, vice president and general manager, Interstate Electronics Corp., Anaheim, Calif., a subsidiary of Interstate Engineering Corp., and **David T. Scott**, treasurer.

**A. R. Atkinson**, controller, Varian Associates, Palo Alto, Calif., succeeding **W. H. Chandler**, now general corporate auditor.

**Van H. Viot**, vice president-industrial relations, Sperry Gyroscope Co., division of Sperry Rand Corp., Great Neck, N. Y.

**Guerard Howkins, Jr.**, controller, Raytheon Co.'s Semiconductors Divisions, Newton, Mass.

**Harry H. Gorman**, deputy director of administration, Marshall Space Flight Center, National Aeronautics and Space Administration, Huntsville, Ala.

**C. K. Faught, Jr.**, special assistant to the Under Secretary for Transportation, Department of Commerce, Washington, D. C.

## Honors and Elections

**Patrick E. Haggerty**, president and director of Texas Instruments, Inc., has been elected president of the Institute of Radio Engineers for 1962 succeeding **Lloyd V. Berkner**, president of the Graduate Research Center of the Southwest. Elected vice presidents: **André M. Angot**, technical director of Telecommunications Radioelectriques et Telephoniques, Paris, France, representing overseas countries; **T. A. Hunter**, president of Hunter Manufacturing Co. and research professor at the State University of Iowa, representing North America.

*(Continued on page 108)*

# INDUSTRY OBSERVER

▶ Major advance in micro-electronics, in the form of thin-film active elements capable of providing amplification, has been made by an East Coast avionics manufacturer under Navy sponsorship. Details are expected to be revealed soon.

▶ **Navy will soon award a contract to Raytheon for development of penetration aids for the Polaris fleet ballistic missile. Contract, expected to total about $1.5 million, will cover development and fabrication of flight test quantities.**

▶ USAF and Navy have awarded several research contracts to determine what type of goggle is best for flight crews to prevent blindness caused by nuclear explosions. Types being investigated are electro-mechanical, photochromic, phototropic and electro-optical. When exposed to a flash, some would become opaque by chemical means, some by electrical means and others mechanically, after being triggered by a photocell.

▶ **Bacon type of primary fuel cell under consideration by NASA to furnish Apollo power requirements is expected to supply an average of two kilowatts during a 14-day mission for a three-man crew, or about 665 watts per man. This is more than two and a half times that projected by Air Force about four years ago for missions spanning Man-in-Space-Soonest, Man-in-Space-Sophisticated, and lunar reconnaissance. The Bacon type of cell, using hydrogen and oxygen, is being developed by Pratt & Whitney Division of United Aircraft Corp.**

▶ Navy Hydrographic Office has asked industry for proposals for 163 sets of "instrument suits" as part of the national oceanographic program to supply information for anti-submarine warfare projects. Suits would be dropped overboard and towed by almost every type of Navy and merchant vessel. They would contain sonic sounding sets, bathythermographs; meteorological cases containing recorders for measuring surface and air temperature, wind speed and direction, incident and reflected solar radiation; and wave meters and magnetometers.

▶ **Bendix Corp. is studying augmentation of ionization trails of decoy re-entry bodies to simulate more accurately the ionization signature produced by the actual re-entering warhead.**

▶ First hardened sites for Nike Zeus anti-missile missiles if the system is approved for operational development will be in the New York area. Other sites are successively planned for the Washington-Baltimore area, Los Angeles, and the Midwest, indicating that population centers rather than military bases will get priority in protection. Site design is progressing with the development of the system.

▶ **General study of radar cross-section measurements relating to re-entry body penetration techniques is being performed for Air Force by Radiation, Inc. Research aimed at reducing radar cross-section of re-entering vehicles is being done by Chrysler Corp.**

▶ Arterial graft system to obtain precise measure of an astronaut's blood pressure during spaceflight is under development by North American Aviation's Space and Information Systems Division.

▶ **Stanford University's electronics laboratory and Planning Research Corp. of Los Angeles are analyzing reconnaissance techniques for Air Force in connection with the Samos satellite program.**

▶ Titan booster for Dyna-Soar boost glider flights will be monitored by an automatic electronic detection system that will trigger the abort operation in case of a malfunction. Dyna-Soar's 12-sec. duration, 40,000-lb. thrust solid rocket motor would propel the 17,000-lb. manned glider to approximately 13,000 ft. at Mach 0.9. Glide flight tests of the Dyna-Soar from a B-52 mother ship will involve firing of the escape rocket system and acceleration to supersonic speed. The glider will be able to land at any airport with runway of 8,000 ft. or longer.

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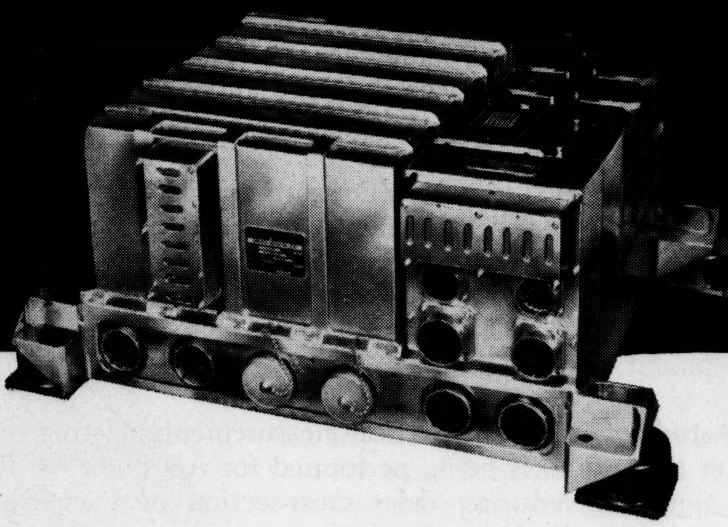

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# NATO V/STOL Transport Proposals Due

Paris—At least a dozen consortiums or companies, some of them with multiple presentations and tie-ins, were expected to submit formal proposals last week to meet the deadline for bids in the North Atlantic Treaty Organization's Basic Military Requirement 4 competition for a medium-range V/STOL transport.

Although NATO officials had anticipated originally that the proposals in this initial phase would be more along the line of statements of capabilities, a number of firms are submitting detailed design specifications on one or more approaches. The top five designs will be chosen for further study before a final decision is made. Proposals also are being prepared for NATO's VTOL strike fighter design competition (see p. 28).

Proposals for the V/STOL transport break down into two general categories—turbojet and turboprop—with the interested firms or consortiums including:

- Ling-Temco-Vought in a consortium with France's Sud Aviation, Italy's Fiat and possibly Dornier of Germany. The design is essentially built around the tilt-wing aircraft that has been selected in the U. S. as the tri-service VTOL transport (AW Sept. 25, p. 352). Powerplants are four General Electric T64 turboprop engines. Ling-Temco-Vought's U. S. associates in the program, Ryan and Hiller Aircraft Corp., also are participating in the NATO competition team.
- Douglas Aircraft Co., with Sud Aviation as a potential partner, along with Piaggio of Italy. Turboprop design is based upon Douglas' entry in the tri-service competition.
- Hawker Siddeley Group with several designs embracing both the turbojet and the turboprop principles. Projects, monitored by a unit known as the Advanced Projects Group with approximately 100 engineers, includes a Mk.2 version of the de Havilland Caribou turboprop transport, a second STOL incorporating T64 turboprops plus lift engines, a version of the Armstrong Whitworth 681 using Bristol Siddeley BS.53 lift-thrust turbofan engines (AW Sept. 18, p. 43), and an entry designated the de Havilland 129.
- Bristol Aircraft Corp. with a scaled-down version of its BS.53-powered BAC 208 in partnership with Italy's Meccaniche Aeronautiche Meridionaci Aerfer and possibly Dornier (AW Nov. 13, p. 33).
- Short Brothers & Harland with an STOL version of its Belfast transport using Rolls-Royce RB.108 lift engines to aid in initial lift (AW Nov. 6, p. 65).
- Handley Page with an STOL version of the Herald transport incorporating General Electric T64 powerplants.
- De Havilland of Canada with its own proposal for a NATO version of the Caribou.
- France's Breguet with an aircraft based upon the blown-wing concept of its 941 STOL transport.
- Italy's Agusta with a novel design based upon use of T64s in both push and pull configurations.
- Dornier with an independent design incorporating Bristol Siddeley lift-thrust engines podded beneath the wing.
- Focke-Wulf with a VTOL built around RB.162s in wingtip pods plus a BS.53 and an STOL aircraft utilizing the T64 turboprop and RB.162s for lift. Potential partners within West Germany are Hamburger Flugzeugbau and Weser Flugzeugbau.

# Soviet Union Claims 100-Megaton Warhead; Emphasizes Anti-Missile

Washington—Soviet military leaders marked Artillery Day, Nov. 19, with claims that Russia has developed nuclear rocket warheads of 100-megaton size. Largest reported nuclear explosion in the recent Soviet test series occurred Oct. 30 and was estimated to have an equivalent yield of between 57 and 60 million tons of TNT.

Russia also criticized U. S. leaders for missing the point of Soviet Defense Minister Rodion Y. Malinovsky's claim that Russia has an effective missile defense system in his speech to the 22nd Communist Party Congress.

In a Moscow radio broadcast, the commentator said Malinovsky "paid a deserved tribute to Soviet rocket units, which can destroy all means of delivery of atomic weapons in the air. In other words, there is an anti-missile for every single missile."

Soviet newspapers printed the anti-missile missile claim, along with assertions that Moscow and other major Soviet Union cities have rocket and radar defenses and networks of fighter plane airfields.

Defense Department sources said the Soviets have the booster capability to launch an intercontinental ballistic missile with a multi-megaton warhead, possibly one with a yield as high as 50 megatons. These boosters are so large and complex that they do not lend themselves to quantity production and training of semi-technical operating crews, these sources said.

In response to U. S. reports that the Soviet Union has only 30 to 50 ICBM's, Col. Gen. V. F. Tolubko, writing in Red Star, said such statements are "vain self-delusion."

"We have much more powerful nuclear warheads and their number is considerably greater than assumed by American specialists," he stated. "And we can assure . . . that our ballistic rockets have proved themselves so wonderfully that nobody has any doubts in their ability to lift and deliver any warhead to any point of the globe."

According to Col. General A. N. Ponomarev of the Technical Service, Soviet bombers are equipped with air-to-ground winged rockets suspended under their fuselages (AW July 17, p. 30). The bombers need not enter the anti-aircraft defense zone of a target for launching, he said.

From the Navy standpoint, Engineer Admiral N. V. Isachenkov said that the backbone of the Soviet submarine fleet is nuclear powered submarines whose range and endurance when submerged are practically unlimited. He also said that the Soviet Navy has cruisers with target-seeking rockets capable of striking enemy ships, particularly aircraft carriers, hundreds of kilometers away.

## BAC Agreements

London—British Aircraft Corp. formally announced a series of agreements with four European firms last week encompassing commercial aircraft production and possible advanced planning plus cooperation in the North Atlantic Treaty Organization competitions for a V/STOL strike reconnaissance fighter and a supporting medium-range transport.

BAC said agreement has been reached with Sud Aviation for cooperation on existing and long-term commercial projects, including an arrangement whereby the French firm will manufacture the tailplanes for the VC-10 jet transport as revealed by Aviation Week Nov. 6 (p. 40).

In other areas, BAC will enter into partnership with Marcel Dassault in submitting a version of the Mirage III-V in the NATO strike fighter competition (see p. 28) and with Italy's Industriel Meccaniche Aeronautiche Meridionaci Aerfer, a Finmeccanica subsidiary, in a proposal for a medium-range V/STOL transport (see above).

# Defense Deliberates Funding of MRBM

Prospective bidders for development of an Air Force medium-range ballistic missile for NATO expect a request for proposals to be issued by year end even though the decision on whether to fund the program still is being deliberated at top Defense Department level.

One complicating factor in the decision-making process is the Army's lack of enthusiasm for the program. This does not involve an objection to the mobile MRBM concept but probably to the fact that the missile would cut into the higher range capability of the Army's Pershing surface-to-surface missile at the lower end of the MRBM range span. If the program is implemented, industry observers feel that it is likely the Army might be given responsibility over the development of the mobility aspects of the weapon system.

## Missile Requirement

Requirements for the missile probably will specify a single-grain, two-stage solid propellant configuration for operation over a range of 200 to 2,000 naut. mi. Short ranges in the operational span would be accomplished with thrust-termination devices. Storable, hypergolic liquid-propellants also were considered, but were not adopted for the propulsion scheme.

Reaction time demand for the operational MRBM system probably will be less than 5 min. In addition to range and reaction time, specific requirements in the work statement may be directed to guidance and mobility capability, missile length and diameter, which would not exceed 40 in. This would be a small grain propellant compared with diameters of 120 in., 240 in. and more projected for the country's upcoming large solid-propellant booster program, and could be handled in above-ground ovens.

The MRBM solid-propellant requirements are not seen as jeopardizing the status or schedule of the large solid-booster program. Otherwise, bidders will have considerable latitude, but will stay within the state of the art, because weapon development would be directed to achieve operational status within four years.

Increase in propellant specific impulse would be desirable but is not likely to exceed present-day capability of approximately 245 sec. Substantially higher specific impulses easily could be obtained but these likely would be research curiosities rather than the stable compounds which would be required to meet the rigors of truck transportation over rough roads.

Method of thrust vector control, likely to be incorporated in both missile stages, almost certainly will be left as an open area. It will probably be covered in a variety of schemes proposed by industry bidders.

## Early Calculations

Initial projections for the system envisioned a missile weighing approximately 12,000 lb., plus about 16,000 lb. for the transporter. Design latitude may allow these figures to increase to as high as 20,000 lb. for the missile and 35,000 lb. for the transporter.

Whether the program will be kicked off as a feasibility study or for development of prototype hardware will depend on the amount of financial support. In any event, about $10 million is expected to be allotted out of Fiscal 1962 funds, if the program is implemented in this fiscal period. Development probably will be on the basis of awards for airframe, systems, and propulsion to contractors of associate status instead of reposing over-all responsibility in a single prime contractor. Aerospace Corp. would supply general systems engineering and technical direction (AW Nov. 6, p. 23).

Question of implementation of the MRBM is spurred by reports that the Soviets have developed two missiles in this category, blanketing ranges to 700 and 1,100 naut. mi., using liquid propellants—probably RP1-type fuel. Both systems are mobile. Sizable numbers of these missiles are expected to be deployed over a period of two years. Reaction time of these missiles would be substantially longer than that required for a solid-propellant MRBM.

One of the arguments against implementation of MRBM is that the development would be solely for NATO, since the U. S. doesn't need the weapon for its own defense arsenal. The mobile version of the Minuteman ICBM, which is under limited development, may be accelerated early next year.

Political factors are favorable for development of the MRBM for deployment in the NATO countries which would operate the weapon. Only consideration which might be subject to negotiation would be responsibility for the nuclear warhead. France and West Germany probably would be the main European users.

## Limitations Examined

One of the aspects of system feasibility undoubtedly has been concerned with effective use abroad, considering limitations which may be imposed by narrow streets, roads, and bridges which may be encountered in countryside areas off main highway routes.

These same considerations would apply if the weapon were tagged for deployment in Asia or Africa. Another factor seen is the opportunity for sabotage of the system, considered to be substantially greater than in the case of fixed missile-sites.

The MRBM essentially is a refinement of the Air Force's small ICBM which was projected under SR 19781 (AW July 18, 1960, p. 26) with basically similar command and control and other technical requirements. Probably only range requirements will be the key change to meet particular deployment demands. Both the MRBM and its predecessor concept

### T63 Engine Tests

**Washington—Phase III of the preliminary flight rating test of the Allison T63 250 hp. free turbine engine aimed at powering the Army's light observation helicopter began Nov. 21.**

**The 50 hours of tests include eight six-hour cycles of takeoff power, cruise power and idle running, and two hours of full power.**

**Failure of a previous engine, which blew up in September when the first stage turbine wheel disintegrated due to wide temperature disparities in its mass, forced Allison into a basic redesign of the compressor section.**

**As a result, the Army two weeks ago decided to request alternate proposals from other engine manufacturers (AW Nov. 20, p. 26). Requirements are for the same horsepower and specific fuel consumption, but no weight was specified.**

**The current T63 has completed Phase I, which consisted of 275 starts, and Phase II, which included a 50-hr. run plus 10 running hours with 25 starts.**

**Another 50 hr. of tests are scheduled for the engine in the inverted configuration, which is the way it will be installed in the helicopter.**

### West Ford Theory

**New theory which holds that Project West Ford type filaments would acquire an electric charge in orbit, producing electrostatic drag that would cause their orbital altitude to decrease at a rate of approximately 1,800 mi. per year, has been advanced by Prof. S. F. Singer of the University of Maryland. This is in addition to the orbital decay that would result from pressure of solar radiation on the filaments. Singer has taken a year's leave of absence from Maryland to serve as a consultant on space sciences to Jet Propulsion Laboratory in Pasadena, Calif.**

the small ICBM system, represent the broad thinking of Space System Division's Col. N. M. Lulejian and his group, which plans and analyzes advanced systems for both Space Systems Division and its companion Ballistic Systems Division, under AFSC's Deputy Commander for Aerospace Systems, Inglewood, Calif.

### Concept Genesis

Mobile ballistic missile concept which fits MRBM now is at least four years old. Gen. Frank F. Everest, (ret.), former commander, Tactical Air Command, is credited with sparking the idea for this type of weapon, loosely known then as the mobile IRBM, for European deployment, when he was USAFE commander from 1957 to 1959.

Space Technology Laboratories, as technical adviser to the former Air Research and Development Command's Ballistic Missile Division, studied the detailed aspects of the mobile MRBM, and these studies were continued and extended by Aerospace Corp. when it succeeded Space Technology Laboratories in its complementary technical role to the Air Force.

Late last month, Aerospace Corp. already had discussed the broad requirements of MRBM with both propulsion and system contractors.

AFSC's Maj. Gen. Marcus Cooper, deputy chief of staff for systems, will head the MRBM effort if it is implemented. Working under him will be Col. M. A. Cristadoro, Col. H. K. Higgenbottom, and Maj. R. Randall.

# USAF May Request 120-in.-dia. Solid Propellant Proposals Dec. 1

Request for industry proposals for the 120-in.-dia., solid-propellant space-projects booster may materialize as early as Dec. 1.

Aerospace Corp. currently is preparing a work statement to cover motor development and is establishing a program for its general systems engineering and technical direction, in accordance with Air Force instruction.

Initial funding for motor development in Fiscal 1962 probably will not exceed $25 million, according to industry estimates.

Development of the 156-in.-dia. booster, previously considered likely as a concurrent project with the 120-in. unit, will not be implemented for the present, but may be phased into the program later.

The 120-in. motor would be delivered to The Martin Co. as government-furnished equipment for use with the Titan III (Titan II with two 120-in. units attached to the base of the first stage) if this vehicle is firmed as a booster for the Dyna-Soar glide vehicle.

Other uses possible for the motor include the Air Force's Phoenix program, the Army's Advent communications satellite, now reported to be considerably heavier than original projections, and for some of the missions tagged for the Atlas-Centaur vehicle.

Meanwhile, propulsion industry members are negotiating with Edwards AFB's rocket base for development work in support of the 120-in. motor, using existing hardware:

- **United Technology Corp.** was negotiating with Edwards on Nov. 15, to conduct three firings for about $2 million. These would include two three-segment 96-in.-dia. units, and a 120-in.-dia. motor to be fired later in the program. United Technology considers the fore and aft closure caps as half-segments.
- **Aerojet-General** was conducting negotiations with Edwards on Nov. 16 for applied research in large motors encompassing a five-segment, 100-in.-dia. motor, and two three-segment 100-in.-dia. units. In its interpretation of segmenting, Aerojet considers each end cap a segment.
- **Lockheed Propulsion Co.,** on Nov. 17, proposed to fire a two-segment 120-in.-dia. motor. Since Lockheed also considers each end cap as a half-segment, this configuration would consist of a single center segment and two end caps. Lockheed studies for thrust vector control by fluid injection probably would include Freon as an inert gas, and also nitrogen tetroxide to supply additional thrust if the exhaust were fuel-rich.

Thiokol Chemical Corp. also was scheduled to make proposals to Edwards for large solid-propellant motor applied research.

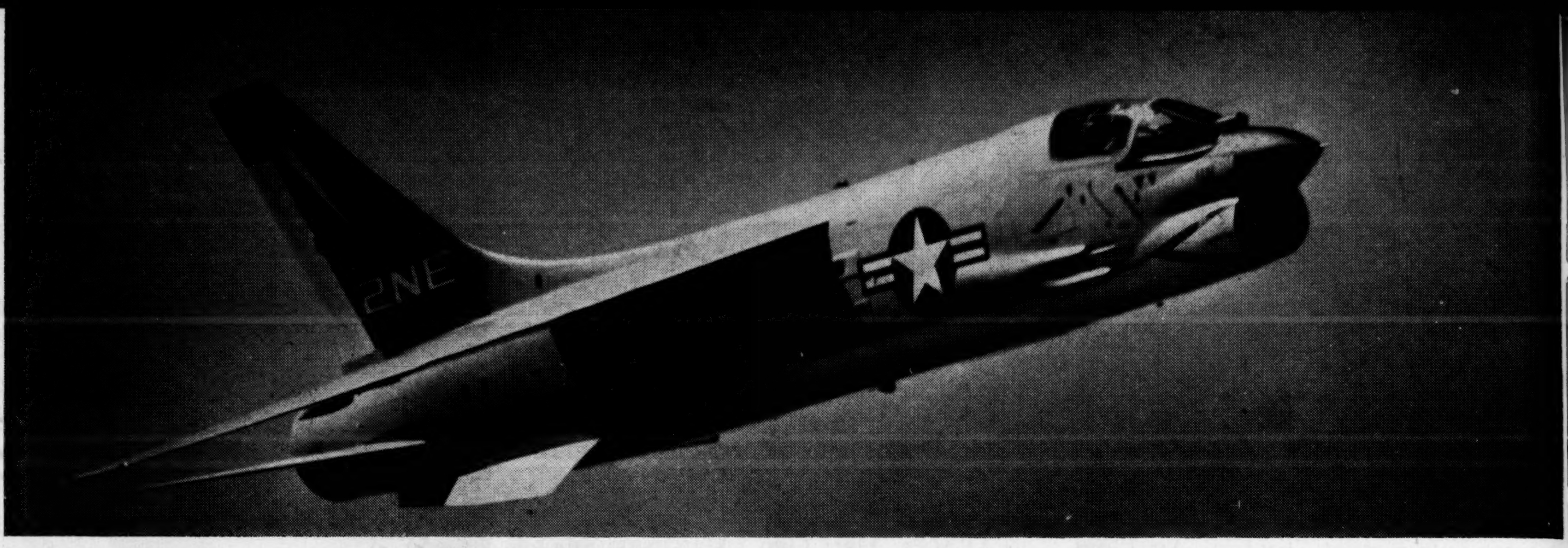
Because the Air Force attaches top importance to the development of the 120-in.-dia. solid-propellant motor, it's likely that the program will be headed by a newly appointed brigadier general in the Air Force Systems Command's Space Systems Division under the deputy commander for aerospace systems. Functioning under this brigadier general would be Col. Langdon Ayres, in charge of motor development, and Col. Russell Harrington for the vehicle.

Lt. Col. David Carter would coordinate the program for AFSC, under Col. Rodney Nudenberg.

Department of Defense effort in the program is the responsibility of John H. Rubel, deputy director of defense research and engineering.

**Minuteman Success**

**USAF-Boeing Minuteman solid-propellant intercontinental ballistic missile was successfully fired Nov. 17 from an underground silo at Cape Canaveral, Fla. First attempted firing from a silo failed when the missile exploded after leaving the hole (AW Sept. 18, p. 63). The Nov. 17 shot traveled some 3,000 mi. Only mishap was a minor one. A door in the silo wall failed to close completely, allowing equipment to be slightly scorched.**



**F8U-2NE Now in Production for Fleet**

**Newest version of the Navy-Chance Vought fighter—F8U-2NE—is now in production at Ling-Temco-Vought's Dallas, Tex., plant under a $58-million Navy contract. Aircraft will remain in production through 1963 under present contracts. The -2NE is powered by Pratt & Whitney J57-P-20 turbojet engine. Larger radar provides increased target acquisition and tracking capability (AW June 12, p. 23).**

## Advanced Nuclear Reactors Planned

**New York**—Phoebus program to develop reactor systems with higher power densities than current Kiwi-B types will be the next step in nuclear rocket development for space flight, Harold B. Finger said here last week.

Finger, director of nuclear systems for National Aeronautics and Space Administration, told a meeting of the Nuclear Energy Writers Assn. that there were further proposals for both gaseous and vortex reactor systems under study as the step beyond Phoebus. But, he added, there is much work that remains between now and then.

Typical example he cited was the necessity to build and test between 30 and 40 complete power reactors before first flight test of a Nerva nuclear rocket engine now scheduled for sometime in 1966 or 1967. All of these test reactors will have restart capability and all will be run through several separate test regimes.

Current thinking is to design the Nerva stage for Rift (Reactor In-Flight Test) as if it were to be the third stage of the nuclear Nova, or Saturn C-4 as it is now called. But this would depend on the time scales of all projects involved and on a decision to use Saturn for the lunar mission.

NASA now feels that orbital rendezvous will best be accomplished with only two stages to join, rather than the multiple-stage assembly jobs that have been suggested. Finger said this could be done by using the first two chemical stages of the Saturn C-4 as booster. Two of these would be needed for each rendezvous. One of them would carry the third (escape) stage of the chemical Nova system and the other would carry the fourth (lunar landing) and fifth (return to earth) stages of the chemical Nova. Rendezvous in orbit of these two payloads would result in a fully loaded, three-stage system ready to go on a lunar-landing mission and return.

Such a system would be all chemically fueled. Finger believes any moon landing program must rely on chemical propulsion if it is to meet the Administration's deadline of "sometime this decade". But he also believes upper nuclear stages must be developed in parallel, so that if they come through in time, they can serve as alternate systems.

In another talk, NASA Administrator James Webb told the Manufacturing Chemists Assn. here that the lunar takeoff system for Apollo manned lunar exploration missions will weigh on the order of 25 tons. Other reports place the total Apollo payload required at 193,000 lb., including escape system.

## Three Powers Resume Nuclear Testing Talks

Soviet Union last week agreed to the U. S.-British proposal for resumption of negotiations on a nuclear test ban Nov. 28 in Geneva, but gave a strong indication it would again walk out if any Western power conducted tests.

The Soviet note stated that "it is, of course, understood that if in the course of the talks any power will carry out tests of nuclear weapons, then by force of circumstances . . . the other side will be compelled to draw the appropriate conclusions with regard to nuclear tests." However, the U. S. indicated in a statement that it reserved the right to conduct tests if it felt they are necessary.

After walking out on the Geneva negotiations, the Soviet Union ended a three-year voluntary moratorium on nuclear testing Sept. 1 by setting off the first of a series of 31 test explosions, including one with a yield of more than 50 megatons. The U. S. conducted four underground tests between Sept. 15 and Oct. 29.

The Soviet agreement to resume test ban negotiations followed by one week the adoption by the United Nations' political committee of resolutions outlawing the use of nuclear weapons in war and banning nuclear testing or stockpiling on African territory. The two resolutions, supported by the Soviet Union and opposed by the U. S. and other Western powers, were approved by wide margins, assuring acceptance by the UN General Assembly. The Western bloc charged "hypocrisy" in the Soviet position and noted that the resolutions provided no safeguards against violations.

Meanwhile, two other phases of disarmament—peaceful uses of outer space and general disarmament—were still deadlocked in the UN over the issue of committee representation. The Soviet Union insisted on its "troika" plan for equal representation by Western, Communist and neutral blocs, but the West refused to accept it.

## Beech's 1961 Sales Down $26.8 Million

Total sales of $72,019,890 were reported for Fiscal 1961 by Beech Aircraft Corp., down from 1960's $98,873,800, reflecting transition of the aerospace industry from manned aircraft and also effects of U. S. business recession in the past year on commercial plane sales.

Approximately 60% of Beech sales in Fiscal 1961 was business aircraft, a total of $43,109,590, and although down over the previous year's $46,570,254, represented a 13% gain over 1959. Military Fiscal 1961 sales totaled $28,910,300, which the company said exceeded its earlier projections for that period, but represented a sharp decrease from 1960's $52,303,546. Business aircraft export sales showed a 31% gain last year over 1960.

Net earnings after taxes totaled $2,562,102, compared with $4,854,059 for Fiscal 1960.

# Ranger Probe Fails; Lunar Shot Still Set

**Washington**—Second attempt to place a Ranger payload into a highly-elliptical orbit failed Nov. 18, but the National Aeronautics and Space Administration still plans to launch a Ranger lunar impact package in January.

Ranger 2 went into a low earth orbit when the Agena B engine failed to reignite after a coast period, the same failure which prevented Ranger 1 from completing its mission (AW Aug. 28, p. 29). Rangers 1 and 2 were designed primarily to test attitude control, solar power and communications systems for lunar-landing Rangers, in an orbit ranging from 37,500 mi. to 685,000 mi. Ranger 2 was injected into an orbit with a 145.7-mi. apogee, 94.9-mi. perigee, and 88.3-min. period.

Dr. A. R. Hibbs, director of Jet Propulsion Laboratory's Space Sciences Division, said JPL must analyze data from tapes before assessing the effect of the failure on the lunar program schedule, but plans were proceeding to launch three Ranger hard lunar landing spacecraft in 1962. Ranger 3 will be launched in January, Ranger 4 in April and Ranger 5 in December under present schedule.

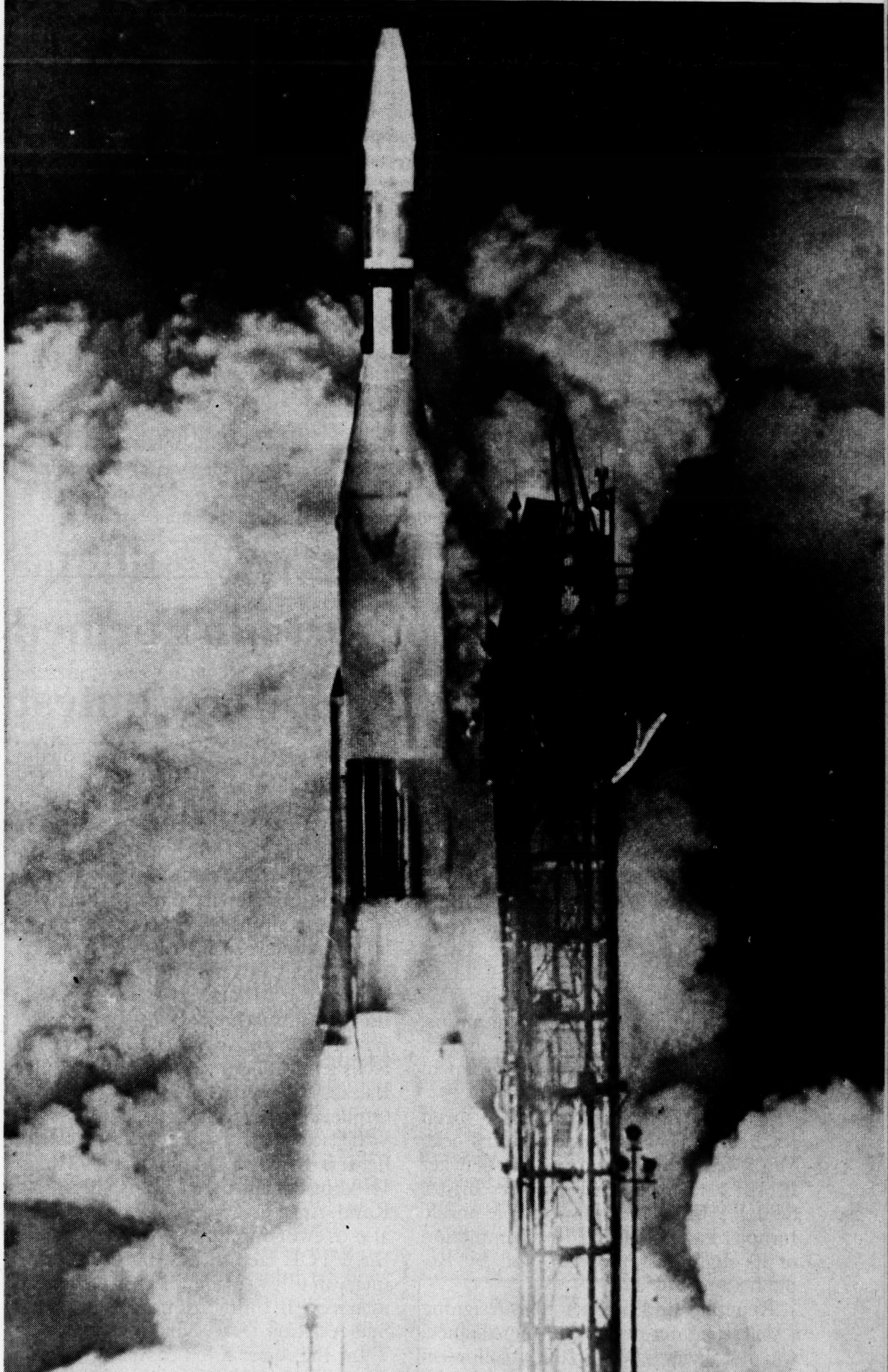
Dr. Hibbs left open the possibility that the Atlas Agena B launch vehicle or the spacecraft may be re-oriented. Ranger 1 and 2 payloads were identical, with electronic components designed for 90-day lifetimes. The remaining seven Rangers are designed for 66-hr. lifetimes, since they will impact on the moon. There is no backup for Rangers 1 and 2, and Dr. Hibbs said it could take six months to a year to build another similar payload.

JPL has been forced to reduce the weight of its Mariner Venus payload from 1,100 to 450 lb. so that it can be flown on an Atlas Agena B instead of a Centaur as originally planned. One alternative in Ranger which is under consideration is use of a Titan II as the launch vehicle.

The Lockheed Agena B has been successfully re-started three times in five attempts. Successes were Discoverer XXIII on Apr. 8, Midas III on July 12, and Midas IV, Oct. 21. The failures have been in Rangers 1 and 2.

Ranger 2 was launched at 3:12 a.m. (EST) from the Atlantic Missile Range and the boost phase included engine cutoff 135.9 sec. after launch, sustainer cutoff at T plus 279 sec., and vernier cutoff at T plus 291.15 sec.

The Agena engine, scheduled to burn for 160 sec., ignited 354 sec. after launch and cut off 149 sec. later. The program called for a 780-sec. coast period while the satellite was in a 100-mi. parking orbit. The second burning cycle was to have lasted for 85 sec.



**LIFT-OFF OF RANGER 2** elliptical orbit satellite occurred Nov. 18, but payload went into low earth orbit. Failure was caused by Agena B engine which did not restart after a coasting period. The same failure prevented Ranger 1 from being completely successful. Ranger 2 was planned to orbit with an apogee of 685,000 mi. and a perigee of 37,500 mi.

## Soviets Claim Records for Titov Flight

**Washington—Certified documentation to substantiate four space flight record claims for Soviet Maj. Gherman S. Titov is being considered by the Federation Aeronautique Internationale, which will act on the claims at a January meeting of the FAI Astronautics Committee in Paris.**

**The Titov dossier was prepared by the Tchkalov Aero Club, and it contains little additional information on the launch vehicle or spacecraft configuration. The launch vehicle is described as a six-engine, liquid propellant rocket with a total usable thrust of 1,323,000 lb. Clustering and staging are not detailed.**

**Flight parameters are given more precisely than those announced after the flight (AW Aug. 14, p. 31), based on data reduction by the Coordinating Computation Center and certified by A. I. Sragovich, identified as department chief. The Titov record claims are:**

- **Space flight and orbital flight durations—25 hr. 18 min.; 17 orbits, each lasting 88.46 min.**
- **Distance and orbital distance traveled—436,937.31 mi.**

**The claims were made at a time when speculation had arisen in Moscow that Russia plans to launch a manned lunar orbital mission in January, and another next fall, in preparation for manned lunar landing in 1964. The U. S. has a 1967 target date for landing a man on the moon.**

**Launch was at 6 a.m. (GMT) Aug. 6 from a cosmodrome near Baikonur at 47 deg. 22 min. north latitude, 65 deg. 25 min. east longitude. Landing was at 7:18 a.m. (GMT) Aug. 7 near Krasney Koot in the Saratov region at 50 deg. 51 min. north latitude, 47 deg. 01.5 min. east longitude. Launch was from the same site used in Maj. Yuri Gagarin's flight (AW June 5, p. 32).**

# Republic Joins Consortium Formed For NATO VTOL Fighter Contest

**London**—Seven aircraft manufacturers, including Republic Aviation Corp., have formed a consortium which will cooperate on construction of a VTOL strike fighter for North Atlantic Treaty Organization if a consortium member wins the NATO design competition.

In addition to Republic the companies are Hawker Siddeley of Great Britain, Focke Wulf of Germany, Louis Breguet of France, Fokker of The Netherlands and two Belgian firms, SABCA and Avions Fairey. The Belgian companies have formed a group to work within the consortium.

Previous agreements had been reached by Hawker Siddeley and Focke Wulf, based on submitting the Hawker P.1127, now powered by the Bristol Siddeley BS.53 Pegasus variable-nozzle turbojet engine and nearing completion of its flight test program, and by Republic and Fokker.

Republic and Fokker are designing a VTOL fighter designated the Alliance, which will use the BS.100, a follow-on to the BS.53 which reportedly is the same general size, but which will produce 38,500 lb. thrust. The airplane generally resembles the Republic F-105 with inclusion of a cranked delta wing (AW Sept. 11, p. 27).

A consortium of this size has been in the making for some time and, in the United Kingdom at least, has been considered a necessity, in view of the fact that the Basic Military Requirement 3 (BMR-3) proposal probably will draw at least a dozen entries. The group formed here is primarily set up for the strike fighter requirement, but possibly may expand its efforts into BMR-4, the tactical transport VTOL, if the future climate proves attractive.

Agreement also was being completed last week between British Aircraft Corp. and Marcel Dassault, to submit a version of the Mirage III-V which would use an unspecified Rolls-Royce main powerplant with a combination of Rolls jet-lift engines. A prototype, called Balzac, is powered by a Bristol Siddeley Orpheus 3 (AW Nov. 20, p. 23).

If accepted as the NATO strike fighter, BAC would build the Mirage III-V in Britain under license to fill the Royal Air Force's NATO needs. BAC also is working on an agreement for the VTOL tactical transport with Dornier, and has made previous commitments with Finmeccanica of Italy and Sud Aviation (AW Nov. 6, p. 40).

In the new seven-company consortium, prime contractor will be the winner of the design competition. Production will be shared among the companies on the basis of facilities and national orders for the NATO countries involved. Under the agreement, companies of other NATO countries can join the consortium. However, consortium members cannot join independently with other firms on the fighter competition (AW Oct. 30, p. 28).

# Institute Will Study Defense Department

**Washington**—Logistics Management Institute, a non-profit corporation formed recently by the Department of Defense, has been awarded a $600,000 contract to study problems of inventory surpluses, modernization of procurement specifications and contract negotiation and incentives.

Secretary of Defense Robert S. McNamara revealed that defense inventories include some $13 billion in surplus equipment, about half it spare aircraft parts. One LMI mission is to recommend methods of adjusting these inventories (AW Nov. 20, p. 26). LMI will also study these problems:

- **Simplification of designs**, standards and specifications. About half of the 23,000 specifications and standards presently applied to contracts are obsolete, McNamara said.
- **Methods of introducing** additional competition in procurement processes. About 60% of defense contracts are now awarded to single source producers.
- **Means of increasing** incentives for high performance. Cost reimbursement type contracts amounted to 42.1% of the total dollar value of Defense Department contracts in Fiscal 1961, compared with 17.9% in Fiscal 1952.

On another subject, McNamara said that the North Atlantic Treaty Organization has 20 formal divisional organizations, but they are undermanned.

When the current buildup is completed about Jan. 1, McNamara stated, NATO will have 25 effective divisions, an increase of approximately 25%. This added strength has been accomplished he said, by "holding in the service of the various countries men that otherwise would have been released. This is particularly true of West Germany; by organizing new units based on cadres of experienced personnel in the existing units; by, in the case of France, returning at least two divisions from Algeria and re-equipping those divisions."

Ground force strength on Jan. 1 will be slightly under goals set by the Military Committee of the military commanders of NATO, he said.

McNamara identified Army reorganization proposals as "Project 80." No final decisions have yet been reached, he said. Army recommendations are believed to include formation of a Combat Developments Command, a Research and Materiel Command and strengthening of the Continental Army Command (AW, Nov. 20, p. 35).

Fiscal 1963 defense budget will be higher than that of 1962, McNamara said (AW Oct. 16, p. 34). New obligational authority in 1962 was increased to $50.4 billion from the Eisenhower Administration request of $44 billion.

## Second Bios Launching Fails

**Pt. Arguello, Calif—Two efforts to launch the NASA Bios space probe to an altitude of 1,165 mi. over the Pacific Missile Range failed because of trouble with the Argo D-8 booster rocket in the first attempt and missile tracking problems in the second.**

**In the first attempt on Nov. 15, the Bios I vehicle veered sharply to the right of course 57 sec. after launch and the payload capsule landed so far from the planned impact area that recovery could not be attempted. Another complete back-up rocket and experiment capsule was ready for another try two days later, but PMR range safety officers postponed it one day because of civilian shipping discovered in the booster impact area.**

**The second launch apparently was successful but tracking signals were erratic and confused and the re-entry capsule beacon signal was never acquired by the recovery force downrange.**

**Bios (Biological Investigation of Space) project is essentially an extension of the NERV (Nuclear Emulsion Recovery Vehicle) project which was conducted successfully on a single shot from Pt. Arguello in September, 1960 (AW Sept. 26, 1960, p. 26). Unlike NERV, Bios experiments deal predominantly with biology rather than the physical sciences. The Bios payload weighs 86 lb. at re-entry compared with 83 lb. for the NERV payload.**

# Hughes Urges Profit-Making Public Communications Satellite System

Washington—Hughes Aircraft Co. called for a publicly-owned profit-making corporation to develop, own and operate a world-wide satellite communications system in a brief received last week by the Federal Communications Commission.

The firm took issue with the recommendation of an ad hoc committee of 10 international common carriers, appointed by FCC, for a non-profit company composed of carriers using the satellite system (AW Oct. 23, p. 28). Hughes declared that this type of organization "would be susceptible to domination and control by its major customers, the giant international common carriers."

Without profit motivation, Hughes commented, "the company would become relatively weak and sterile. It would have less incentive to improve the quality of its service to its customers or to lower the cost of its operations to satisfy the elastic demand for international telephony, television and data transmission."

Hughes' proposal for a company financed by public stock subscription was also favored by Western Union Telegraph Co., a member of the ad hoc group, in a minority report.

Hughes also supported the proposal by Western Union and General Telephone & Electronics Corp. that the new management organization own all ground installations as well as the satellites (AW Nov. 20, p. 28). The ad hoc group recommended that the ground stations be separately owned by the various carrier users.

Under a unified ground-space system, Hughes declared, "a stronger technical solution will inevitably result. Unless they are operated as a unit the record and books of account cannot reflect fully the total investment and expenses in the communication satellite system, which would be necessary in order for the public to receive the lowest rates. If the ground stations are owned by the present carriers . . . their costs will be intermixed and confused with costs resulting from other services in establishing the rate base of the carriers."

Hughes urged quick formation of a satellite system management, and volunteered to supply the equipment necessary for "a fully operational" system capability within one year. Under Project Syncom, negotiated with National Aeronautics and Space Administration in August, Hughes is developing a 22,300-mi. altitude nonstationary synchronous orbit satellite that will travel an elongated "figure eight" pattern 33 deg. north and south of the equator at a longitude near the U. S. east coast.

Hughes proposed a system of three high-altitude synchronous orbit satellites for global coverage and estimated the cost of this system at $60 million, plus $15 million in engineering costs. Only one satellite would be launched by each booster. The company said that its cost estimate is "based on the conservative assumption of 50% launch success probability."

Each satellite would have four transponders operating on separate frequencies and with independent power supplies. With this design, three satellites, rather than three pairs of satellites, would be needed for global coverage.

## Four Zeus Launchings Test First Two Stages

Pt. Mugu, Calif—Army's Western Electric three-stage Nike Zeus has completed four successful flights in a week at Pacific Missile Range and White Sands, N. M., to test propulsion, missile aerodynamics and guidance and control elements of the first two stages.

Two of the successful test launches have been made at each site. Objectives were the same in all four launches.

In September, the second stage of the first Nike Zeus launched from Pt. Mugu exploded in midair (AW Sept. 18, p. 34). The second Nike Zeus launched from Pt. Mugu was automatically destroyed at termination of first-stage burning after a component failure (AW Oct. 16, p. 32).

Tests from Pt. Mugu, Nov. 16 and 21, were made from a simple rail-type launcher rather than the operational silo-type launcher used at White Sands, where two firings were made on Nov. 15. There are no plans to duplicate the expensive operational launcher here.

Ground-based guidance and control elements evaluated in the Pt. Mugu tests include the missile track radar, target intercept computer and command guidance transmitter. A partial Nike Zeus control center is set up near the site of the missile launcher.

In the two successful tests the target intercept computer was supplying taped commands for test maneuvers.

The aerodynamic function of the Zeus canard control system has now been flight tested. The jet-head motor, doubling as a reaction control power source and final sustainer motor firing through nozzles in the trailing edges of the aerodynamic surfaces, including the canard fins, is to undergo its first flight tests from Pt. Mugu.

The Pt. Mugu tests were launched at an angle of about 15 deg. downrange as a safety measure because of the missile's rapid (700 ft. per sec. per sec.) initial acceleration. In neither case was the first controlled maneuver made before first-stage separation, about five seconds after launch.

## Nike Zeus Target

**Cape Canaveral—General Electric nose cone that will be a target for tests of the Army's Nike Zeus anti-missile missile in the Pacific next year was launched successfully Nov. 21 over a 5,000-mi. trajectory by a USAF-Martin Titan J missile. Assembly, countdown and launch of the missile and cone were conducted by the Ballistic Systems Division's 6555th Aerospace Test Wing, the first all-USAF crew to launch an ICBM from Florida.**

# 'Serious Overstaffing' in Pentagon Slows Decisions, Jackson Charges

**Washington** – "Serious overstaffing" in the Defense Department and other national security agencies is causing "sluggishness of decision and action," Sen. Henry Jackson (D.-Wash.), chairman of the Senate Subcommittee on National Policy Machinery, charged in a statement marking the end of his group's two-year study.

"The size of the national security departments and agencies has swelled out of proportion even to the increased number and complexity of our problems," Sen. Jackson declared. Although the payroll cost is "formidable," the cost in inefficiency is even more important, he said.

"Unnecessary people make for unnecessary layering, unnecessary clearances and concurrences, and unnecessary intrusions on the time of officials working on problems of real importance. Many offices have reached and passed the point where the quantity of staff reduces the quality of product," Sen. Jackson said.

The fight against overstaffing "must be waged each day anew," he said. "Occasional swings of the personnel axe, accompanied by such fanfare, yield more in headlines than in lasting results."

Many recommendations of the Jackson subcommittee have been accepted by the Kennedy Administration. These include firmer guidance from State Department on how the Defense Department can implement foreign policy; more emphasis on individual responsibility, particularly of cabinet members, and less dilution of authority through inter- and intra-departmental committees; reduction in the "paper mill production" activities of the National Security Council; the appointment of outside task forces of experts to make recommendations to the White House and government departments on specific subjects.

Other highlights of Sen. Jackson's statement were:

- **Radical additions** to our existing policy machinery are "unnecessary and undesirable." Proposals for cold war strategy boards and councils of wise men to advise the President, Sen. Jackson said, "violate sound administrative practice by tending to interpose officials between the President and his key cabinet officials. They rest on the mistaken assumption that the weaknesses of one organization can be cured by creating another."
- **Heart of the problem** "is getting our best people into key foreign policy and defense posts." More often than not, Sen. Jackson said, poor decisions "are traceable not to machinery but to people. . ."
- **State Department** generally "attaches too little importance to looking ahead in foreign policy, and is too wedded to a philosophy of reacting to problems as they arise."
- **Budget Bureau** should be strengthened, not weakened—a position at odds with that taken by Sen. Stuart Symington (D.-Mo.) and other congressional leaders, who have complained that the bureau has decided defense issues by fiscal actions. "The budgetary process is the President's most helpful tool in establishing . . . an order of national priorities, and in seeing to it that the operating programs of the departments and agencies conform to these priorities," Sen. Jackson said.

# Overtime Authorized For Space Workers

**Washington**—President Kennedy last week reiterated that U. S. leadership in space is a "vital national objective" and authorized the National Aeronautics and Space Administration to allow its laborers and mechanics to work overtime.

A NASA spokesman said this would affect a limited number of its employes since most of them already were allowed to work overtime because of the high priority given space projects.

The President's executive order said: "the attainment and maintenance by this nation of a clearly leading role in aeronautical and space achievement has become a vital national objective. . . ."

# News Digest

**Field Army Ballistic Missile** Defense System (FABMIDS) development contract is expected to go to a General Electric-Chrysler team following a review by Dr. Harold Brown, director of defense research and engineering (AW Nov. 20, p. 25). Phase I studies were conducted on the system by five contractors.

**French civil aviation budget** for 1962 includes $2,400,000 for Super Broussard development. First production model of the twin-turboprop airliner is expected to fly early in January. Although no firm orders have yet been received, production plans call for 12 Super Broussards to be completed during 1962. First pressurized version will fly in December, 1962. Price of non-pressurized version with two Turbomeca Bastan turboprops is $290,000. Pressurized model will sell for $320,000.

**Marshall Space Flight Center** will establish a financial management office Dec. 1 at Cocoa Beach, Fla., and a purchasing and contract office there Jan. 2. These offices will support National Aeronautics and Space Administration launch operations at the Atlantic Missile Range.

**USAF Discoverer XXXV** was recovered by a Lockheed JC-130 within 15 mi. of Tern Island Pacific Missile Range tracking station after launch Nov. 15 from Vandenberg AFB, Calif. Recovery was made Nov. 16 on the 18th orbit rather than on the 17th as planned (AW Nov. 20, p. 35).

**Members of seven** craft and laborer unions failed to respond immediately last week to Labor Secretary Arthur Goldberg's order to end a walkout at the National Nuclear Test Facility at Mercury, Nev. The walkout, caused by a jurisdictional dispute between two unions, affected work on underground testing, Nerva, Kiwi B and Pluto programs.

**Riddle Airlines** last week proposed a night coach fare between New York and Miami lower than all current air, rail and bus rates. The airline also proposed increasing free baggage allowance from 40 to 100 lb. The new rate would be $29.84 night coach between the two points. Riddle now operates only cargo and charter service.

## Air Cushion Contract

**Washington—Navy Bureau of Ships expects soon to award a contract for the design and construction of an air cushion vehicle 20 ft. x 65 ft. and weighing about 28 tons. It would be the biggest such craft ever built by the U. S.**

**The vehicle's purpose is to test the practicability of using the craft over water. Navy hopes the vehicle will travel at least 70 kt. riding 2½ ft. above the surface. Officials feel this would enable the craft to fly over waves up to 3½ ft. high.**

**The craft will be powered by four Solar Saturn 1,100-hp. gas turbine engines, and have side skegs and an annular jet. Delivery of the vehicle is expected in mid-1963. Seven proposals were received by the Navy last July. Bureau of Ships may conclude negotiations with one of the contractors by next month.**

**Britain next year is to test a similar vehicle, built by Saunders-Roe. Known as the SRN-2, the British vehicle is designed to carry 66 passengers over water.**

St. Mark. D'Annunzio previously had served in the cavalry and navy, but won great distinction for his daring bombing raids. He was wounded a number of times, and by the end of the war had won six medals for bravery. He later was proffered the title Prince of Monte Nevoso.

The plane in which he flew to Vienna on the propaganda raid is still preserved in the "Vittoriale," D'Annunzio's estate near Brescia, which is maintained as a public museum by the Italian government.

The S.V.A.-5 was among the most efficient and structurally unusual planes of the era. Powered by a 6-cylinder, water-cooled vertical S.P.A. engine, the plane's top speed at sea level was a remarkable 143.7 mph. Rated at 210 hp., the engine actually delivered 225 hp. at 1700 rpm. The ship could climb to 10,000 feet in 8 minutes, 10 seconds, and to 20,000 feet in exactly 22 minutes.

Armed with two Vickers guns—which were mounted just forward of the cockpit on either side of the cowling—the S.V.A.-5 weighed 1984 pounds when loaded. This included a 573-pound load consisting of pilot, armament and fuel. The plane's most distinguishing feature was its fuselage, which was rectangular in front and triangular behind the cockpit.

The aircraft was designed by Ing. G. Verduzio, whose first consideration had to be the area over which the ship would fly. To strike at their primary enemy, Austria, the Italians had to achieve unusual range. In addition, the Italian Flying Corps had the problem of going over the Apennines and the Alps to reach Vienna or Munich, which necessitated high maneuverability.

At war's end, nearly all pursuit squadrons were equipped with the S.V.A.-5, and other tactical units of the corps were flying the S.V.A.-4 bomber, a sister ship incorporating virtually identical design principles. Together, these planes formed the backbone of Italy's air strength against the Central Powers from the summer of 1917 until victory.

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# Fare Issue May Be Used to Push Mergers

## Airlines believe Board may reject pending requests for increase to sharpen interest in consolidations.

By Robert H. Cook

**Washington**—Speculation that the Civil Aeronautics Board intends to accelerate airline interest in mergers by rejecting bids for fare increases gained momentum last week as carriers awaited Board action on a variety of fare proposals.

Continental Airlines' filing for a "no frill" coach service (AW Nov. 6, p. 37), scheduled to become effective on Dec. 1, is openly regarded by the industry as a test of CAB's low-fare philosophy against the trunklines' hopes for extensive fare increases to offset the record net losses expected this year.

The Board must either approve or disapprove the Continental fare before the end of this week and act shortly afterward on a fare increase proposal filed by United Air Lines, which would become effective Jan. 1. In addition, Eastern Air Lines and Braniff Airways have taken the unusual step of requesting CAB approval of their suggested fare increases by Dec. 1, before they commit themselves to formal tariff filings.

### Victory for Board

Psychologically, the Board appears to have won an initial victory in its battle to hold the line on fares, because of these developments:

- **Continental**, with the industry's highest profit margin and lowest load factor, walked away with implicit CAB approval of the new reduced-fare coach idea when the Board examined and approved a special seat designed for this service.
- **Trans World Airlines** and American Airlines, both directly competitive with Continental on routes from Chicago to California plus several routes in the Southwest, filed strong objections to the low-fare idea, but decided to institute the service as a competitive measure. TWA also asked permission to extend its present transcontinental jet excursion fares and add a new and lower piston coach fare between New York and California.
- **United is thus faced** with the prospect of demanding a fare increase while its major competitors hold down or reduce fares in competition along transcontinental routes. The CAB must answer this increase proposal by Jan. 1, but many observers believe United will withdraw its proposal if the Board approves the Continental filing. United later filed to meet the TWA excursion fares.
- **Alan S. Boyd**, CAB chairman, set the stage for a fast shift in airline optimism on fare increases in a recent speech at Hartford, Conn. (AW Nov. 6, p. 37) by denouncing the approach of seeking fare increases as a means of curing the industry's financial ills.

In a further statement, considered as a blunt ultimatum to the industry, Boyd urged an acceleration of merger talks and warned that unless the airlines take such action, CAB might develop and publicly disclose its own merger report, spelling out specific carriers which should be merged.

- **National Airlines**, shortly after the Boyd speech, withdrew its request to raise its coach fares to within 85% of first-class fares. Later, it filed for a new "no-frills" coach fare between Boston, Washington and Miami.
- **Eastern wrote a letter** to CAB asking a Board opinion on a proposed fare increase of 5% to 7%. The carrier explained that it chose this course of action to avoid any unnecessary expenses that might be incurred in filing a tariff that CAB might reject. Eastern said the proposal also would include abandoning food and beverage service on coach flights—a move that Boyd has strongly urged, but that industry has not yet agreed on.
- **Braniff, in a similar letter**, inquired about the possibility of a 6% to 7% fare increase, with the additional proviso that it would also drop food and beverage service on coach flights.

### Strikers Reclassified

**London—Ministry of Aviation last week maneuvered around an official government wage freeze for its employes, by reclassifying 1,000 loaders at London Airport to settle a strike (AW Nov. 20, p. 38).**

**Loaders, striking for five cent hourly hike, have been upgraded to the position of baggage masters, effective Dec. 1, a job calling for the wage increase which started the dispute. Hardest hit was British European Airways, which claims a loss of $750,000 because of flight cancellations.**

Consensus of opinion now is that there is little hope for any fare increases until after the industry's year-end financial figures are tallied.

### Profit Outlook

Last year the domestic trunks earned a meager $1.2-million profit, with a profit margin of only 0.1%. Debt interest totaled $43.8 million to produce a 2.7% rate of return on investment, or $127 million less than is needed for the industry to realize the CAB approved rate of 10.5%.

With a current net loss position of more than $17 million, projected estimates of the industry's financial status by the end of this year indicate an expected profit margin of −1.1%, with a debt interest of $60 million and a rate of return of less than 2.2%.

Unable to generate enough total traffic volume to offset revenue losses from the increasing amount of low yield coach traffic, many carriers feel that a fare increase of more than 10% is needed to recover these losses at the present rate of growth, which has plummeted from 15.3% in 1959 to only 3.9% last year.

Fare increases already suggested do not take into account either the industry's continuously rising wage costs or the strong possibility of a full system of user charges to cover the cost of operating the federal airways system, airline officials point out.

Salaries alone absorb an estimated 42 cents of each revenue dollar earned by an airline, one spokesman said. Of this total, crew costs are more than 13 cents. Fuel costs and taxes, which would be severely affected under any extensive user charge program, currently claim 14 cents of the dollar.

Earlier studies by a Senate transportation committee have estimated that a user charge system might cost the airline industry $190 million a year, requiring a 7-11% fare increase.

As an example of the impact of rising wage costs on airline earnings, a United brief noted that increases granted this year have raised operating expenses by $7 million. United estimated that its requested fare increase would raise revenues about $27.5 million, but would produce a rate of return of only 5.2%.

## McNamara Tightens Supplementals Rules

**Washington—Defense Secretary Robert S. McNamara ruled last week that each supplemental airline must receive Military Air Transport Service clearance to carry military personnel within the continental U. S. Supplementals also were barred from carrying individually-ticketed military passengers in the U. S. by the same order.**

**Apparently prompted by the Imperial Airlines crash that killed 74 Army recruits on Nov. 8 (AW Nov. 20, p. 37), McNamara's ruling empowers MATS to pass upon the technical and financial capability of every supplemental airline interested in obtaining military business.**

**Supplementals carrying military personnel overseas have been subject to similar inspections for several years.**

**McNamara's action, which became effective Nov. 17, will divert all military passengers traveling on an individually-ticketed basis in the U. S. to trunklines and local service carriers. This eliminates an important revenue source for the supplementals.**

# CAB Grants Emergency Hearing On Financial Aid for Northeast

By Ward Wright

Washington—Civil Aeronautics Board has granted Northeast Airlines a summary hearing on Nov. 29 to consider interim approval of emergency financial aid from Hughes Tool Co.

The Board took the action after Northeast warned CAB that failure to allow Hughes Tool to give it immediate financial help (AW Nov. 20, p. 39) would force the airline to ask for subsidy or go into bankruptcy proceedings.

CAB said the Northeast financial picture was serious enough to warrant "extraordinary measures to cope with the situation." The Board said it would set aside normal procedures used in a full evidentiary proceeding, narrow the scope of the issues, and hear oral arguments on Nov. 29.

Oral argument is ordinarily the last procedural step before the Board's final decision.

### Hughes' Control Assumed

The Board said that it would restrict issues to the question of interim financial relief. For the purpose of the hearing, the Board said, it would assume that Hughes Tool already controls Northeast or will if financial assistance is granted.

CAB noted that it was aware of Northeast's claim that control by Hughes Tool does not exist and would not if it received financial aid, but that it was "wholly unpersuaded" on that issue and would not explore it further at present.

In addition, CAB said that whatever it decides on interim financial aid, "there will remain for later decision, after a full evidentiary hearing . . . the question whether acquisition of control of Northeast by Toolco [Hughes Tool] is adverse to the public interest."

Earlier, Northeast told CAB that Hughes Tool would not be willing to render financial aid unless Hughes Tool could be assured that such action would not subject it to penalties if it later purchased Atlas Corp.'s holdings in Northeast.

Northeast asked for "clarification" of the Board's order on this subject. The Board replied that it was not prepared to alter its earlier convictions that Hughes Tool may already be in control of Northeast and could not "clarify" the order.

Eastern Air Lines, National Airlines and Hughes Tool were named parties to the hearing by CAB. All parties were allowed to file briefs and affidavits by Nov. 24.

Shortly before the Board set the hearing date, Eastern sent a sharply-worded telegram to CAB terming the Hughes Tool offer to aid Northeast a "power play" with three aims: to dispose of 17 jet transports Hughes Tool owns, to use its "vast resources" to drive Eastern or National or both from their New York-Florida routes into financial distress and to eventually sell the valuable route.

Eastern said if the Northeast request were not summarily denied, the CAB should refer the entire matter to the Attorney General for a full investigation.

### National's Plan

National, commenting on Northeast's request for clarification, told CAB that if Northeast goes bankrupt, the Board "need shed no tears" for Atlas, Hughes Tool or Shell Oil Co., which provides fuel for Northeast, because these firms were in a position to see the financial danger coming. National said if the $3 million Northeast owes Shell were deducted from the total $6 million Northeast said it owes, the remaining $3 million due smaller creditors could be "salvaged from the remains."

Vickers Aviation, Ltd., which holds equipment trust certificates on Northeast's Viscounts, filed a brief to clarify its position. Vickers said it would investigate what could be done "within reason" to help Northeast.

In October, Vickers said, it refused a plan to allow Hughes Tool to further subordinate its second chattel mortgage on Northeast's piston aircraft with a second lien.

The idea of the second lien was to allow Hughes Tool to guarantee a Chase Manhattan Bank loan to Northeast to meet part of its expenses until the end of the year. Vickers said the plan had the effect of making holders of Northeast's equipment trust certificates secure the Chase Manhattan loan. Vickers rejected the plan as being financially unsound.

As of the middle of last week, a Northeast spokesman told Aviation Week, Northeast was operating a full schedule and that a "satisfactory arrangement" had been made with Shell, which earlier had said it would demand cash for fuel after Nov. 17.

Allegheny Airlines notified CAB last week it would cooperate if its services were needed to fill any service gaps in the Northeast-Allegheny area. It also said it objected strenuously to suggestions by Eastern and National that Mohawk Airlines be granted exemption authority to serve Northeast's New England routes. Such routes are primarily local service operations, according to Allegheny, and if there is to be any transfer of local service obligations it should be on an "orderly" basis.

## Local Service Talks

**Washington—Civil Aeronautics Board Chairman Alan Boyd last week asked local service airline presidents to meet with him in January to discuss subsidy, re-equipment, capacity and management problems.**

**Boyd said local service re-equipment programs have so far resulted in increased subsidy. He said he expects new equipment cost will make 1963 the peak year for subsidy, followed by three years of declining subsidy needs. Boyd said he expects local service subsidy for 1963-66 to be $74, $73.8, $71.5 and $67 million respectively.**

**Boyd said CAB will intensify its "use it or lose it" policy, allow maximum experimentation with fares and fare levels and bring about greater operational flexibility by permitting new nonstop and skip-stop authority. Boyd said management will have to apply for suspension of non-productive routes and consider capacity increases carefully.**

# Revisions in FAA Policing Policy Urged

By David H. Hoffman

**Washington**—Federal Aviation Agency rule-making and rule-enforcing procedures are expected to become more democratic, more consistent and more decentralized as the Agency implements recommendations submitted to it last week by the Project Tightrope task force.

The initial step in this direction—formation of an Agency Regulations Council within the office of FAA Administrator N. E. Halaby—was taken last week when the Agency disclosed the contents of the Tightrope report. The council, to be headed by Halaby, would perform these functions:

- **Create FAA** rule-making policies and procedures.
- **Determine** when notice of a proposed rule should be issued.
- **Ensure** that rule-making petitions from outside the Agency are given "serious consideration."
- **Demand** complete justification before drafting any rule proposed by an FAA official.
- **Oversee** a vast FAA project aimed at re-codifying and streamlining rules already on the books.
- **Supervise** and coordinate the issue of internal directives drafted to implement all FAA rules.

In addition to Halaby, the FAA's deputy administrator—when one is appointed—the directors of the Air Traffic Service and Flight Standards Service, the civil air surgeon and the Agency's general counsel will sit permanently on the council. Day-to-day management of the group will be handled by an executive director. W. Lloyd Lane, chief counsel for FAA's central region, has been picked for this post and is scheduled to take office Jan. 15.

## Report Recommendation

Lloyd Cutler, a Washington attorney, served as chairman of the Tightrope task force. In accepting his report, which took four months to prepare and write, Halaby said: "We intend to adopt in principle, with certain exceptions, the report's major recommendations on rule-making."

The report suggests that functions of the rules council should be assigned to an "assistant administrator for regulations" who would act on the advice of a committee composed of top-ranking FAA officials. Halaby's administrative reorganization of FAA virtually rules out such a chain of command.

The report was sharply critical (AW Oct. 16, p. 47) in its examination of the machinery set up to enforce FAA rules already enacted. It noted that in the 12 months following former FAA Administrator Elwood R. Quesada's "crackdown" on infractions, a period that ended on June 30, 1959, violation reports jumped 50% from 2,092 to 3,128. During the next 12 months, 4,448 violations were reported.

Enforcement officials in FAA's Washington headquarters were unable to cope with this "burst of activity" from the field and the entire complicated system was choked, the report said. As a result, Quesada ordered his inspectors to use more "judgment" in filing their reports. Violation reports fell from an average of about 370 per month to 285, a rate that is continuing, the report said.

An even greater decrease in the number of cases reaching Washington followed Quesada's order. Even so, the report noted, about 55% of the reports processed through FAA's headquarters here were quashed by Agency officials.

"No matter how scrupulously fair is the treatment of individual cases, an agency which ultimately drops so many of the proceedings it starts, and which takes so long to lay a hand on those it does laboriously decide have violated the regulations, must expect the fairness of its system to be questioned," the report said.

## Hearings Urged

To remedy this situation, the Tightrope task force recommended that in cases involving the revocation or suspension of a certificate issued by FAA, the Agency offer the accused a "trial-type hearing" before an independent hearing examiner. This officer would be empowered to decide cases and impose punishments subject to the review of the administrator. If an accused party rejected the offer of a hearing, his action would be construed as an admission of guilt and the case would be ended. After a hearing, however, the accused could appeal to the Civil Aeronautics Board.

FAA's field inspectors, totaling 900, are not necessarily good investigators, the report said. To require that they both uncover and investigate violations dilutes their effectiveness, it said. Greater efficiency could be achieved by the appointment of a "specialized investigative-enforcement staff."

Almost all enforcement cases now are subjected to "multiple internal reviews" by FAA, the report said. This system should be "severely pruned" and consistency secured by policy directives and general regulations.

The report recognized that FAA's rapid growth rate resulted in "some disorder" during the Agency's formative years. To illustrate, Dec. 31, 1958, the day FAA came into existence, through Apr. 30, 1961, the Agency processed 68 final Civil Air Regulations, of which 24 were first published as proposed rules; 125 regulations of the administrator, of which 25 were published originally as proposals; 258 airworthiness directives, 92 of which were published in proposal form; and 1,109 airspace actions, almost all of which were first disseminated as proposals.

This volume of activity, according to the report, helped produce these problems:

- **Power to enact** rules was exercised separately by individual FAA services—Flight Standards and Air Traffic, for example. As a result, the underlying philosophy, the format and the formal procedures expressed often varied widely from rule to rule.
- **Conflict between** the office of the general counsel and Flight Standards Service on their "respective roles in the rule-making process" seriously delayed the promulgation of vital rules.
- **Internal directives** were given the force of formal rules. "The Agency," the report said, "ought not to regulate under the guise of talking to itself."
- **Issued or inherited** rules of FAA are "lacking in orderly organization, inconsistent in terminology, composed in scores of writing styles, frequently ambiguous, often mislabelled, with no one having a complete set of 'everything' and with no central table of contents or index to permit swift and certain reference."

Notices of proposed rule-making, the report said, frequently are published only after "the Agency has largely made up its mind" on the subject at issue. Hearings that follow assume the character of formalities. If, however, FAA simply described the subject and the issue to be covered by a proposed rule, the aviation community could play a more significant part in rule-writing.

FAA should hold a greater number of public hearings, as opposed to evidentiary proceedings with formal cross-examination of witnesses, before deciding on the final form of a regulation, the report said.

FAA, in the area of enforcement, has resorted to practices not shared by other bureaus of the federal government, the report said. In certificate actions, for example, the administrator has been empowered by Congress to "punish first, then justify his action at a subsequent trial," the report said.

The Tightrope task force was composed of Cutler, John F. Floberg, Louis J. Hector, Frederick B. Lee and Gerhard P. Van Arkel. Alfred B. Fitt was chief counsel.

## SAS May Cancel 990 Order

**Copenhagen—Scandinavian Airlines System is considering a number of financial retrenchments, including possible cancellation of its order for Convair 990 medium-range jet transports, reduction of schedules and layoff of flight and technical personnel, in an effort to offset continuing losses, according to Danish Minister of Public Works K. Lindberg.**

**SAS management also is considering a request for new bank credits beyond the approximately $30 million advanced early this year by the governments of Denmark, Sweden and Norway (AW Mar. 29, p. 34).**

**The minister said that traffic over the airline's North Atlantic routes had declined 4% in the fiscal year ending Sept. 30 below that registered during the previous year.**

**Outright cancellation of the two 990s on order from Convair plus two it had planned to obtain on a lease basis from Swissair might prove difficult, primarily because of the team agreement with Swissair under which the latter carrier would maintain the 990s.**

**The Danish official told Parliament that SAS plans to cut its summer schedule from last season's high of 21 flights per week to New York to a total of 14 and to trim its South African and South American schedule from two to one per week.**

# CAB Examiner Declares Airline Credit Programs Are Unlawful

**Washington**—Initial decision by a Civil Aeronautics Board examiner that credit plans used by scheduled airlines are unlawful will, if affirmed, force the industry to completely revamp its traditional Universal Air Travel Plan.

CAB Examiner Ralph L. Wiser found that airline credit plans are unlawful in that they extend credit without charge and are not available to all passengers on equal terms. If the Board approves, he would have the industry readjust its credit programs within 90 days after the Board acts.

Although all credit programs would be affected by the order, the Universal Air Travel Plan, which has been the backbone of the airline credit system since 1936, would be hardest hit. Subscribers to the plan are required to deposit $425 with the airlines, and the amount of deposits held by the industry has reached substantial proportions.

### Wiser's Recommendations

Under Wiser's recommendations, airlines would be required to charge subscribers to the Universal Air Travel Plan 2% of the amount of the first billing and 1% on all rebillings. In addition, carriers would be required to pay 5% interest annually on customer deposits, with the interest to be credited on monthly billings.

An estimated 25% of all transportation on scheduled airlines is now purchased under this plan. Subscribers total nearly one million. American Airlines, which has the largest number of UATP accounts in the industry, showed credit deposits totaling $10.3 million in its Dec. 31, 1960, annual report.

Wiser reasoned that UATP provides "a valuable service which gives the passenger afforded credit an undue preference and advantage and subjects all other passengers to an undue prejudice and disadvantage." He added:

"It is found that the $425 deposit requirement of the Universal Air Travel Plan is unlawful unless interest thereon is paid in that it is unrelated to the volume of business and therefore results in different charges to different customers for air transportation, in violation of section 403 (b) of the Act."

Wiser also found other carrier credit plans and noncarrier credit card plans unlawful. Carrier credit plans are those offered by airlines, in addition to the UATP for travel over their own routes. Braniff Airways, for example, offers an On-Line Courtesy Credit Plan to persons who have established credit to Braniff's satisfaction.

Noncarrier credit card plans include general purpose programs such as those offered by the American Express Co., Diners' Club and the Hilton Credit Corp. Several airlines have agreements with one or all of these organizations.

An annual service charge is collected from the card holder. American Express, for example, charges each customer $6 per year. In addition, the airline pays a percentage of sales to the credit organization: 2% to American Express, 4% to Hilton and Diners' Club.

Wiser found that use of such cards is lawful only if the airline charges the credit company the full tariff rate for all tickets. He further recommended that carriers bill the credit agencies within 15 days after ticketing and that the carriers should be paid within seven days.

With respect to self-ticketing arrangements, in which airlines provide large firms with blocks of tickets, carriers would be required to charge 1% of the ticket costs if payment is not received within five days and 1% per month thereafter until full payment is received.

Carriers argued that credit is a long-established practice which has been supported by the CAB. They held that the credit practice is lawful, a convenience to the public, and stimulates business.

### Public Unwilling

They said the public is unwilling to accept a credit charge.

Wiser stated that the CAB has never focused attention on the question of whether credit customers should be charged for the service. He added further:

"Sound policy requires that charges be geared to cost wherever practicable. Application of this policy would require that users of air transportation pay a price reasonably related to its cost, that users of an accessorial service such as credit pay a price reasonably related to its cost, and that those who do not want a particular accessorial service be able to buy air transportation without paying for the accessorial service."

## Cunard Loses Award

**London—Cunard Eagle Airways last week lost its fight to establish jet service on the North Atlantic when Minister of Aviation Peter Thorneycroft upheld an appeal by the state-owned British Overseas Airways Corp. (AW Oct. 2, p. 42).**

**Thorneycroft thus over-ruled the Air Transport Licensing Board, which last June granted Cunard Eagle a 15-year license to operate jet aircraft in competition with BOAC between London and New York.**

**Before the minister's decision, Sir Fred Pritchard, commissioner appointed to hear the appeal, recommended rescinding of the license on the grounds that BOAC has commitments on aircraft purchases—45 Vickers VC.10s—to cater for all the traffic expected for the next five or six years.**

**Pritchard also said the advent of another British flag carrier would cause material diversion from BOAC. Both points were keystones in BOAC's case against the Cunard Eagle license.**

**Thorneycroft claimed that withholding a license on grounds of traffic diversion would not necessarily have the effect of freezing the route, and added that diversion of traffic from other foreign airlines was highly problematical.**

**Cunard Eagle's chairman, Harold Bamberg, said Cunard's orders for two Boeing 707s were firm and were not conditional on getting the North Atlantic route.**

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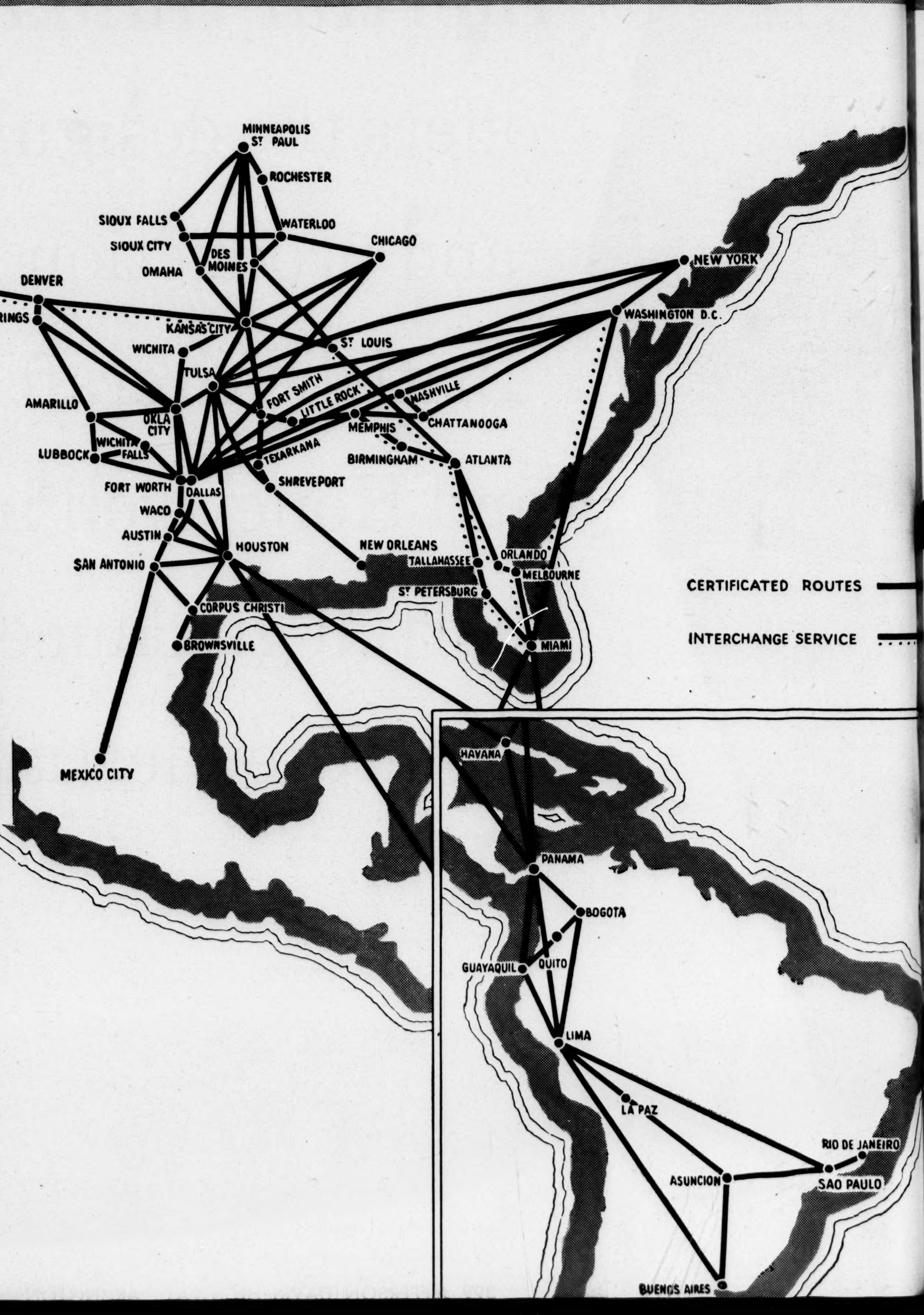
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**Charles E. Beard, President, Braniff International Airways** has this to say of the decision to order the One-Eleven. "After devoting more than a year to comparative analysis, it is our conclusion that the BAC One-Eleven is the short haul jet best adapted to the routes on which we plan to operate them. The economy of the BAC One-Eleven combined with its operating characteristics makes it unusually suitable for an operator with our kind of route over which most of the flying is on segments of 250 miles or less. We already have large jets for the longer hauls. The BAC One-Eleven will bring economical and comfortable jet travel to the customers who make the shorter flights."

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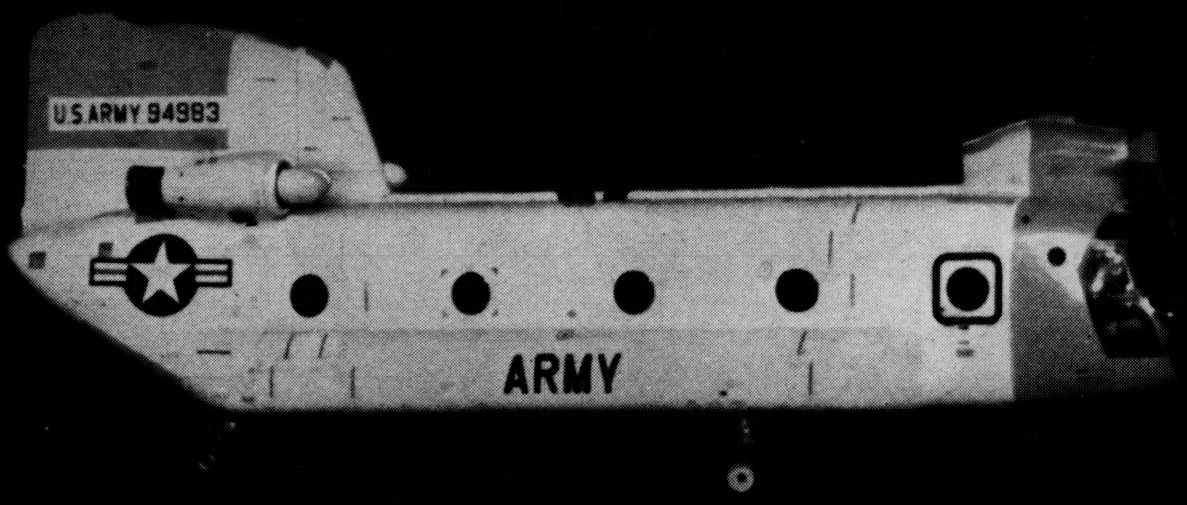
**IN PRODUCTION AND NOW FLYING.** Specifically designed to fill the need for an all-service heavy transport helicopter, HC-1Bs are now in large-scale production. With less than five hours logged following initial forward flight, the first HC-1B flew 150 miles an hour—at a gross weight higher than normal maximum. Since then it has flown at 150 mph for long periods, under various operating conditions. Pilots' test reports consistently read "No major problems." The new helicopter, in addition to aircraft carrier compatibility, embodies the features required by both the U. S. Army and U. S. Marine Corps—large cargo compartment, rear loading ramp, freedom from balance problems and inherent flotation capability.



BOEING VERTOL HC-1B CHINOOK AT 1,500 FEET DURING FLIGHT TEST.

VERTOL DIVISION
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## Aeroflot Draws Gibes From Soviet Magazine

**Moscow—Russian satirical magazine Krokodil says Aeroflot can expect a continuing volley of editorial brickbats until the Soviet monopoly airline provides its passengers with better terminal facilities.**

**Three special Krokodil correspondents en route to Vladivostok issued the warning in describing their experiences in Khabarovsk, where they landed following a nonstop Tu-114 flight from Moscow:**

**"We found that there would be no plane going to Vladivostok that day. 'How about tomorrow?' we asked.**

**" 'You'll find out about tomorrow's planes tomorrow,' the elderly lady at the information bureau replied with a yawn. 'Don't be in such a rush. Spare your nervous system.'**

**"Then we learned that there was no place to spend the night. The airport hotel had filled up long before. And so, after admiring the lights of nighttime Khabarovsk, we returned to the airport towards morning. Here sleep reigned supreme.**

**"People snored in chairs and on the floor. They dozed on souvenir shop counters. They saw sweet dreams doubled up in telephone booths.**

**"Transit passengers lay especially thick on the second floor, where the office of Comrade Andreyev, the airport chief, is located. Since he doesn't get to work until 9 a.m., sleeping was fine outside his door.**

**"We boarded the Vladivostok plane firmly convinced that Aeroflot's management doesn't want to lose Krokodil's friendship and is determined to continue providing it with material for satirical articles and caricatures."**

# FAA Shifts Development Emphasis To Follow Project Beacon Plan

### By Philip J. Klass

**Washington** — Federal Aviation Agency has started to reorient its development effort to follow Project Beacon recommendations and is preparing a system design plan as a guide to future development.

Preparation of the plan has been assigned to a 14-man team, headed by Albert Brown, which was recently formed by Joseph D. Blatt, director of FAA's Aviation Research and Development Service (ARDS), to perform a function previously lacking in the agency.

Eight of the team members will be experts in different operational aspects of over-all traffic control system design, while five members will be specialists in the technical disciplines required for system implementation. Team members will devote full time to the project. All but three positions on the team have been filled. Members are:

Airspace structure, Russell L. Biermann; airports, Robert S. Nickelsberg; rules and procedures, Albert R. Ridenour; human factors, H. R. Van Saun; facilities configuration, Arthur L. Webster II; external system interfaces, Col. Samuel Mundell; aviation weather support, Cdr. John W. Hinkelman, Jr.; data acquisition, Lawrence E. Shoemaker; communications, Walter W. Felton; navigation, Alexander B. Winick.

The agency is seeking candidates for the three remaining slots: aircraft performance characteristics, data processing, and data display. Salaries will go as high as $19,500, an indication of the top-level personnel being sought.

The team is now studying the Project Beacon report, recommendation by recommendation, with initial emphasis on the terminal area problem. As problem areas requiring further study are disclosed, they are assigned to appropriate specialists. For example, before it can be determined how long in advance it is feasible to assign specific landing slots to individual aircraft, it is necessary to determine how far in advance weather conditions can be accurately forecast in the terminal area. Problem would then be assigned to the team weather expert.

By staffing the team with men representing a broad spectrum of talents and experience, FAA hopes to develop a plan which is technically feasible and operationally practical. Present plans call for a technical advisory board, headed by Richard R. Hough, who directed the Beacon study, to meet with the team monthly to review its program and progress (AW Nov. 6, p. 29). Blatt also plans to hold a progress review every three months with the FAA administrator and the directors of each of the other FAA services.

Creation of the team reflects Blatt's intention to have FAA itself perform many of the over-all system engineering and design studies which the agency previously contracted out to industry. In a recent report to FAA Administrator N. E. Halaby, Blatt said:

"The complete and effective design of an ATC/Nav system requires specialized knowledge of many technical disciplines and operational practices. There is no single organization, or group of organizations, outside FAA with all of the requisite knowledge and experience."

Blatt also indicated that FAA itself intends to contract and manage the development of subsystems, rather than work through prime contractors, to assure closer FAA control of the development and its compatibility with the agency's concepts.

Although the Beacon report clearly recommends reorientation of FAA's previous effort in developing a semi-automatic traffic control system, the change does not now appear to be drastic in terms of the hardware and techniques developed under the previous program.

In a report to Halaby, Blatt said that a working paper provided to the Beacon task force by ARDS "is reflected throughout the Beacon report. With very few exceptions, the equipment and procedures proposed in the Project Beacon report are now and have been in the process of development by ARDS."

The Beacon recommendation that radar become the primary reference for traffic controllers and that the flight progress strip become secondary reverses the concept on which the previous system was designed. This probably means that the provision for automatic updating of individual flight strips by the traffic control computer on each controller's console will be abandoned in favor of a simple high-speed printer, which would periodically print out a whole panel of new flight strips incorporating any changes in flight plan since the previous printing.

However, many of the consoles designed to display radar and aircraft arrival-departure sequence in the terminal area can probably be used in the Beacon type system with only slight modification, according to Brown.

The experimental system, currently installed at FAA's National Aviation Facilities Experimental Center (NAFEC) in Atlantic City, will be used as a test bed for evaluation of techniques recommended by the Beacon report, Brown said. NAFEC had been working on the en route portion of the system, but has now shifted emphasis to the terminal area problem.

Project Beacon recommended that radar beacons with automatic altitude reporting provisions be used to provide height information, but the FAA plans to continue its present evaluation of the Maxson height-finder radar, Brown said.

The team has not yet considered the question of data link, and the extent to which the FAA should continue its efforts in this field.

# Australia May Ease Rigid Airline Control

By L. L. Doty

**Melbourne**—Australia's 10-year-old policy of rigid control of competition in civil aviation is still undergoing severe tests that could bring about a revision in domestic airline route patterns.

There is no question that the policy, which is aimed especially at preventing excessive capacity and wasteful duplication of schedules, has attained some success in providing Australia with the airline service it needs. But there is serious doubt that the policy will promote Australia's airline system into a strong, self-sustaining business enterprise with a sound potential for future growth.

## Government Policy

Essentially, the policy calls for a single flagship carrier serving international routes only, a dual airline system operating under rigid government, yet non-subsidized, control on all domestic interstate routes and a highly subsidized feeder line system serving essential rural and developmental routes.

Although government-owned, the international carrier—Qantas Empire Airways—has been granted substantial operational independence and thus has become a strong international competitor, particularly on the Sydney-London "Kangaroo" route and the Sydney-U. S. route. On the basis of revenue ton miles handled, Qantas ranked as the world's seventh largest carrier in 1960.

## Controlled Competition

The two domestic carriers—the government-owned Trans-Australia Airlines and the privately-owned Ansett-ANA—do not enjoy such freedom. The government requires them to compete with one another on most major routes, which is often economically inefficient. Yet it controls that competition by requiring each carrier to provide no more than 50% of the available seat capacity on a given route, by directing the type and quantity of aircraft each carrier will purchase and by indirectly regulating routes, schedules, rates and fares.

Surprisingly, the incumbent Liberal government, headed by Prime Minister R. G. Menzies, appears to favor Ansett-ANA, often at the expense of its own airline, TAA. Undoubtedly, this is due to the fact that the Liberals unwillingly inherited the state-owned airline when it wrested control in 1949 from the Labor Party, which while in power, was bent on nationalizing major industries. As a result, the free enterprise-minded Liberal government has unwittingly made Australia's domestic airline system a political issue. In fact, the favor with which the opposition says the Liberals treat Ansett-ANA may become a significant part of Labor's platform in the federal election next month.

Despite the shortcomings of the present airline make-up, many critics admit openly that the over-all policy is working better than originally anticipated. Service is exceptionally good. Domestic fares are the lowest offered in most other countries, despite two increases totaling some 15% in the past year.

## Government Backs Expansion

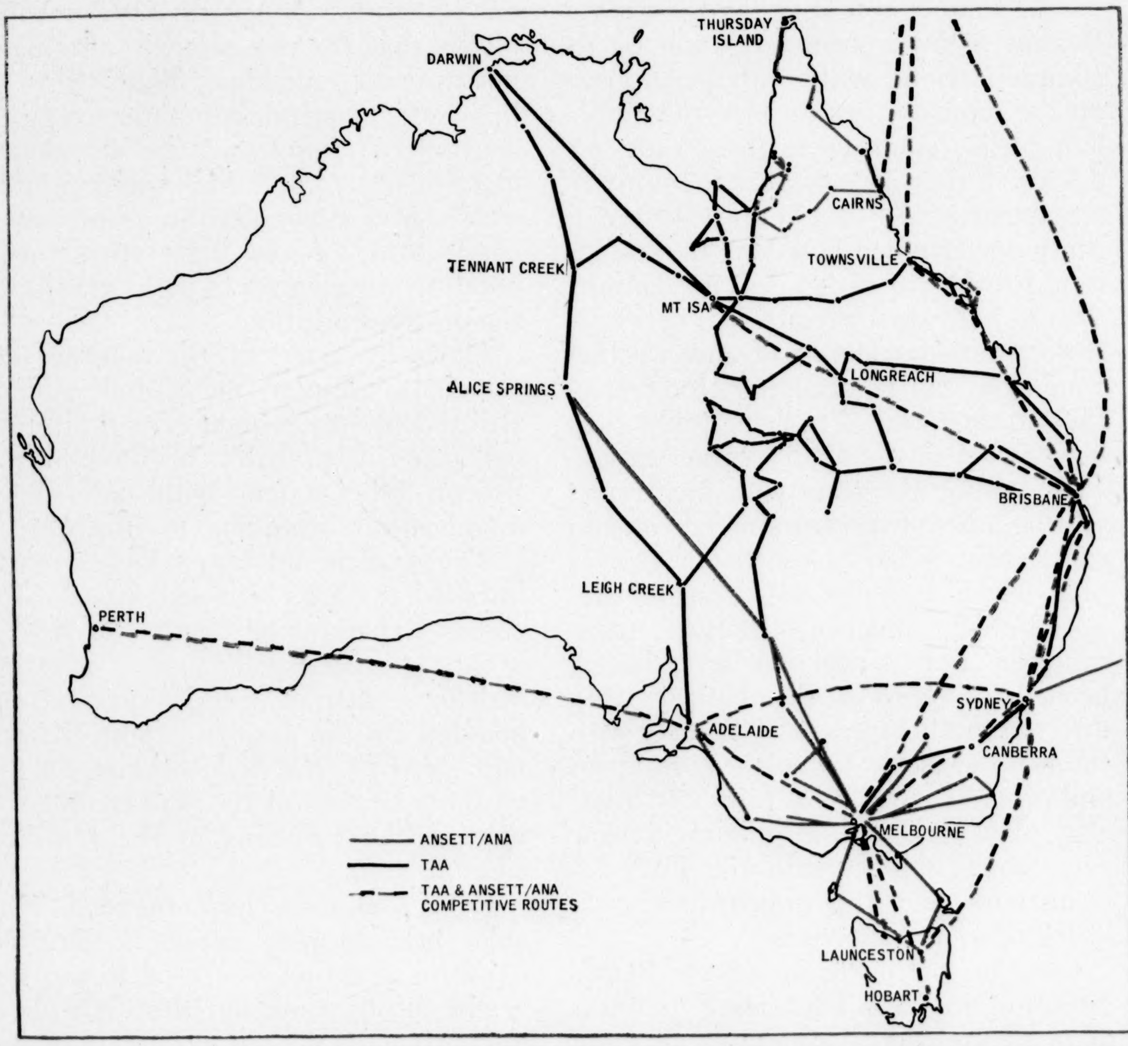
Expansion of developmental routes into untapped areas is continually sponsored by the government. And 72,000 mi. of unduplicated air routes have linked major cities with many rural and bush communities which are inaccessible by modern surface transportation.

However, Australia's 10.5 million people, 70% of whom live in the southeast corner of a continent roughly the size of the U. S., do not produce high-density traffic, although Australians, on the basis of population, use scheduled air service more than travelers of any other nation. Many economists here claim that Australia's airline policy has created an over-abundance of competition; that the country's small population cannot support it.

In the past, the government has reasoned that competition on major domestic routes will automatically produce better service, a philosophy that has an historic parallel in the U. S. It also believed that stiff control of this competition would not quash individual initiative on grounds that each carrier would intensify its drive to increase revenues by achieving high load factors rather than by scheduling extra capacity.

It now appears that the government is having some doubts over the effectiveness of this policy. For the 12 months ending June 30, domestic traffic declined 1.2% compared with the same period last year. The government is viewing the decline as particularly serious since the profit rate of the domestic industry is not much over a marginal 2%.

As a result, the government has hinted that a continuance of the competitive system depends entirely on future traffic growth, although it has not



**MAP** shows domestic trunkline competitive and non-competitive routes served by Australia's two regional carriers: the government-owned Trans-Australia Airlines (TAA) and the privately-owned Ansett-ANA. The trunk routes are supplemented by a wide network of development or feeder services, which are not shown on the map. The network of feeder lines serves remote areas of the continent.

specifically made a directive to change its policy.

There are signs that the government is anxious to reduce competition and the feeling here is strong that Ansett-ANA will be the beneficiary and that TAA will be the victim of such a move. If the Labor government returns to power, which is not considered likely, TAA would emerge as the leading carrier.

Thus Australia's domestic airline industry faces the possibility of a slow but steady change in the present government's civil aviation policy, or the more remote chance of an abrupt change if another political party comes to power.

At first glance, this fluid situation might suggest that the airlines are discouraged from maintaining top performance. Nothing could be further from the truth. Between 1954 and 1959, both domestic and international carriers in regular transport operations had a perfect safety record. In 1960, accident fatalities were 1.33 per 100 million passenger miles. Aircraft utilization is high, on-time performance is above average and the airlines are staffed by competent and experienced airlines technicians.

### Agreements Extended Authority

The federal government originally was granted jurisdiction only over aviation safety matters. Its power to regulate competition and control capacity—the core of the present civil aviation policy—stems solely from agreements signed with TAA and Ansett-ANA. The agreements were extended by Parliament last month for a 10-year period only after a hot political debate, indicating the controversial character of the policy.

First agreement was signed in 1952 after the Liberal government concluded that it was opposed to a single national airline serving domestic trunk routes against uncontrolled competition. The Civil Aviation Agreement, therefore, provided that the government-owned TAA and the now defunct, privately-owned Australian National Airways should serve Australia's primary domestic routes.

Under the agreement, both airlines were to have equal access to mails and government business. Loan guarantees were to be afforded ANA. The agreement also required the airlines to keep under review "... air routes, timetables, fares, freights and other related matters. ..." In the event of failure to agree on any point, an arbitrator would be appointed to resolve the difference.

From the beginning, the agreement was not entirely successful mainly because of TAA's obvious advantage over ANA.

## Dodgers to Fly in Customized Electra

**Los Angeles Dodgers baseball team has taken delivery of a Lockheed Electra transport after it was fitted with custom interior and paint scheme at Horton-Horton and Inter-America Modification center in Fort Worth, Tex. The aircraft has seats for 64 passengers and sleeping accommodations for 4.**

Equipment purchase was an example. TAA bought Convair 240s while ANA bought Douglas DC-4s, giving the former an advantage with the higher speed and pressurized cabins of the Convairs. Later, when ANA re-equipped with the Douglas DC-6B, TAA went a step further by introducing the popular turbine-powered Vickers Viscount.

Meanwhile, Ansett Airways and Butler Air Transport, both of which were operating outside the provisions of the agreement, provided additional competition to ANA. As a result, ANA's financial situation deteriorated until, in 1957, it sold out to Ansett, forming Ansett-ANA.

Subsequently, Ansett obtained control of Butler and its subsidiary, Queensland Airlines and later, with the implicit encouragement if not the full support of the government, absorbed five other airlines, so that today there are but three independent feeder airlines operating within Australia; McRobertson Miller Airlines, operating in Western Australia and Northern Territory; Connellan Airways serving Northern Territory; and East West Airlines, operating in New South Wales.

The Civil Aviation Agreement of 1957 was enacted primarily to bring Ansett-ANA under government regulation but, at the same time, the act was rewritten to enunciate clearly the government's policy in civil aviation. This is the pertinent new clause which was added:

"One of the objects of the parties to this agreement is to secure and maintain a position in which there are two, and not more than two, operators of trunk route airline service, one being the Commission (TAA), each capable of effective competition with the other. ..."

To prevent recurrence of an equipment imbalance in competition and to enable Ansett to introduce turboprop aircraft on its route, the government enacted the Airlines Equipment Act of 1958. This legislation again authorized the Minister for Civil Aviation to guarantee loans undertaken by Ansett-ANA to buy aircraft and in addition, to determine the number and types of aircraft to be used by both airlines.

The government, under the act, was also empowered to regulate capacity provided on both competitive and noncompetitive routes. The purposes of the act were to limit the importation of new aircraft to the real needs of the industry and to increase profit by limiting capacity.

So far, turbojet service has not been introduced domestically. Earlier this year, the government authorized each carrier to purchase two turbojet transports for delivery after 1964. Orders cannot be placed before 1962, although both airlines are now making technical evaluations of available aircraft. Final decisions will be geared to a government warning that acquisition of the turbojets will be based on the need for additional capacity resulting. The government added that it does not intend "to approve a wholesale replacement of the existing turboprop fleet which will continue in use for many years."

The present government's concern over capacity as related to equipment is reflected in a statement by the Minister of State for Civil Aviation, Shane Paltridge, at the recent International Air Transport Assn. annual general meeting in Sydney last month (AW Oct. 23, p. 33). He said:

"Although many dire warnings were given by ICAO [International Civil Aviation Organization] and others in the middle 1950s about the likely consequences of providing jet aircraft in excess of the needs of estimated traffic in the early 1960s, the international airline industry today is grossly overprovided with jet aircraft and load factors have fallen to uneconomic levels. This threatens the continued financial stability of the . . . industry."

Australia's philosophy of austerity in equipment purchase was further underscored by the Prime Minister when, at the IATA meeting, he warned that the industry cannot try to "keep up with the Joneses whatever the cost of keeping up with the Joneses may be." He added: "The last thing . . . I want to happen is to have international or domestic flying—civil aviation in the broad—to be regarded as something that is inevitably solvent . . . or is something that inevitably cannot live except with massive subsidies."

In February, the two-airline policy was extended into New Guinea when Ansett absorbed Mandated Airlines and began service in competition with TAA. Papua is served by Papuan Air Transport, which last year carried 14,596 passengers over its 345-mi. route system.

Subsidies paid for operations over non-competitive and "developmental" routes totaled slightly over $1 million for the year ended June, 1961. In addition, the federal government plans to provide funds to state governments for the further development of airports throughout the country to expand services provided by the feeder airlines.

At present, only Sydney, Darwin and Brisbane airports are equipped with runways adequate for turbojet aircraft. Plans are under way to expand the main runway at the Perth airport and an additional jet runway will be added to the Sydney airport by extending an existing runway into Botany Bay. Sydney is the main port of entry for international flights.

In April, 1960, the Commonwealth government transferred the air routes operated by Qantas between Australia and New Guinea, and those within New Guinea and Papua, to TAA and Ansett-ANA. Beginning in July, 1960, both carriers shared equally in a five flights per week scheduled on the Sydney-Brisbane-Port Moresby-Lae route. Now, each carrier operates three flights weekly.

Later TAA acquired the assets of Qantas in the New Guinea-Papua area and, early this year, Ansett-ANA purchased Mandated Airlines, internal operator in New Guinea, which earlier had bought out Gibbes-Sepik Airways and Madang Airlines. Since provisions of the civil aviation agreements apply to all carriers controlled by Ansett, the effect was to extend the dual airline system with an equal share for each airline of all traffic to and within New Guinea.

# Varig's Jet Orders Linked to Goal Of Globe-Circling Service by 1963

**New York**—Varig Airlines of Brazil expects to become a round-the-world carrier within the next year or so, according to Reuben M. Berta, the airline's president.

Varig's international operation until last spring covered routes between New York, Rio and Buenos Aires and from New York to the Caribbean and Brazil. Then it bought 50% of the voting stock of Aerovias Brasilia, the international division of Real Airlines, with routes to Miami, to Los Angeles and to Tokyo (AW May 15, p. 45). Last August, Varig purchased Real entirely, taking over domestic as well as international routes.

Under Varig management, the old Real route to Tokyo was suspended pending replacement of piston equipment by jets. Berta told Aviation Week that jet service to Tokyo will be inaugurated next April on a weekly basis and increased to twice weekly by the end of next year.

Goal for the 1962-63 period is to extend the Tokyo route on to Bombay, Cairo, Casablanca and Rio to complete the round-the-world circuit. Also, Varig is seeking routes beyond Tokyo to Hong Kong and Bangkok, Berta said. The government of Thailand, he said, has already indicated that a Brazilian carrier should provide airline service to Bangkok.

To handle the expanded international routes, Varig expects to take delivery of three Convair 990s next January, February and March. These airplanes originally were ordered by Real for Aerovias. Berta said financing for the 990s has not been completed, but down payments have been made and the additional financing is being arranged through the Export-Import Bank. The transpacific service will be operated with 990s and with 707-420s. Varig now has three of the Boeing jets.

In addition, Berta said future equipment needs perhaps will call for purchase of another 707-420 and two or three more Caravelles. Varig now operates two of the French medium-range jets.

## Domestic Routes

On the domestic side, Varig wants to turn more of its routes over to the former Real domestic pattern, making the Real operation a domestic subsidiary of Varig, with the latter airline becoming primarily an international operator. About 50% of Brazil's domestic service is now provided by the Varig and former Real routes, Berta said, and 60% of the international service. Varig is expected to remain a domestic operator along the coast of South America to feed its international routes.

To strengthen the Varig-Real pattern from an equipment standpoint, types of aircraft will be reduced and possibly Electras will be ordered to handle some domestic routes. Berta said about eight Electras are under consideration to replace some existing piston equipment. Fleet to cover both Varig and Real route structures would involve eight aircraft types instead of the present 10. For the Real pattern, Electras, Convair piston-engined equipment, DC-3s and C-46s would make up the fleet; Varig's pattern will be handled by Caravelles, 707-420s, 990s, and possibly Electras.

Varig's absorption of Real reduces the number of Brazil's international operators to two. It has been expected that ultimately one carrier will carry the Brazilian flag, and this development now depends on what happens to Panair do Brasil.

Berta said merging of Panair will not be on Varig's initiative, and that he knows of no definite steps in that direction at present by the government of Brazil. Before the recent resignation of Janio Quadros as Brazil's president, the government had strongly favored consolidation of the country's international carriers both for purposes of economy and to make Brazil's aviation a national instrument of policy (AW July 17, p. 41).

Aviation policy of Quadros' government has basically been taken over by the new government, Berta said, but details are still under study.

## Jet Operations

Varig last week began jet service between Los Angeles and Rio via the west coast of South America. A route between the two points had been operated by Real, and has been operated with piston equipment by Varig since it acquired Real. However, the old route, which Varig was operating under the Real name, ran Los Angeles-Mexico City-Panama City-Bogota-Manaos-Rio. The new route, which Varig will operate under it own name, pending government approval, runs Los Angeles-Mexico City-Bogota-Lima-Rio. Lima was not in the old Real route pattern, but Varig is tying it into the Los Angeles service.

Berta said he expects a financial improvement over this route with the shift to jet equipment. However, Varig is asking the Brazilian government to extend for another five years government subsidy to cover the current international operations and the domestic DC-3 routes.

# AIRLINE TRAFFIC — SEPTEMBER, 1961

| | Revenue Passengers | Revenue Passenger Miles (000) | Passenger Load Factor % | U.S. Mail Ton-Miles | Express Ton-Miles | Freight Ton-Miles | Total Revenue Ton-Miles | Over-All Revenue Load Factor |
|---|---|---|---|---|---|---|---|---|
| **DOMESTIC TRUNKS** | | | | | | | | |
| American | 662,190 | 533,365 | 63.8 | 2,039,465 | 1,061,278 | 11,354,374 | 65,607,506 | 55.9 |
| Braniff | 186,276 | 90,034 | 57.8 | 407,050 | 214,128 | 1,070,515 | 10,325,112 | 47.1 |
| Continental | 109,285 | 73,937 | 46.0 | 261,692 | 133,228 | 679,124 | 8,168,553 | 39.0 |
| Delta | 281,997 | 167,108 | 54.9 | 623,117 | 399,555 | 1,839,822 | 18,918,856 | 47.6 |
| Eastern | 615,704 | 295,956 | 44.8 | 1,298,308 | 585,847 | 2,580,625 | 32,977,868 | 36.5 |
| National | 132,788 | 91,765 | 50.9 | 381,667 | 92,376 | 1,280,874 | 10,611,185 | 39.0 |
| Northeast | 124,243 | 52,531 | 44.7 | 155,581 | 74,723 | 254,825 | 5,518,571 | 38.1 |
| Northwest | 150,985 | 109,512 | 52.6 | 648,917 | 277,745 | 1,334,805 | 12,764,665 | 45.6 |
| Trans World | 413,163 | 398,420 | 56.8 | 1,569,011 | 848,468 | 5,608,156 | 46,226,953 | 47.7 |
| United | 966,415 | 650,475 | 56.4 | 3,882,928 | 1,408,134 | 8,960,267 | 76,581,421 | 50.2 |
| Western | 146,823 | 86,839 | 56.0 | 304,439 | 95,484 | 403,661 | 9,123,041 | 44.4 |
| **INTERNATIONAL** | | | | | | | | |
| American | 7,512 | 7,923 | 53.4 | 6,641 | 1,071 | 301,207 | 1,127,872 | 47.1 |
| Braniff | 18,349 | 27,474 | 68.1 | 53,291 | 10,933 | 192,188 | 2,966,752 | 55.9 |
| Caribbean Atlantic | 32,981 | 2,280 | 62.3 | 1,963 | ....... | 10,988 | 226,072 | 54.2 |
| Delta | 1,518 | 1,788 | 35.2 | 794 | ....... | 10,542 | 200,850 | 33.4 |
| Eastern | 38,129 | 55,154 | 58.1 | 1,064,536 | 1,669 | 324,816 | 5,623,393 | 56.8 |
| Mackey | 7,232 | 1,207 | 31.1 | ....... | 278 | 3,970 | 122,543 | 31.1 |
| National | 87 | 50 | 58.1 | ....... | ....... | ....... | 5,375 | 47.5 |
| Northwest | 20,664 | 40,958 | 61.3 | 1,519,651 | 7,112 | 782,296 | 6,634,924 | 65.5 |
| Pan American | | | | | | | | |
| Alaska | 5,819 | 6,042 | 39.8 | 41,968 | 3,578 | 274,174 | 956,984 | 42.8 |
| Atlantic | 180,599 | 293,162 | 57.8 | 2,941,269 | ....... | 6,807,072 | 39,862,602 | 52.9 |
| Latin America | 11,351 | 20,122 | 65.7 | 99,927 | ....... | 696,901 | 2,957,152 | 61.0 |
| Pacific | 45,442 | 185,993 | 69.3 | 3,302,181 | 17,189 | 3,588,402 | 25,884,340 | 60.6 |
| Panagra | 11,351 | 20,122 | 65.7 | 99,927 | ....... | 696,901 | 2,957,152 | 61.0 |
| South Pacific | 145 | 396 | 36.2 | 295 | ....... | 4,151 | 45,320 | 33.0 |
| Trans Caribbean | 6,599 | 10,504 | 80.9 | ....... | ....... | 187,969 | 1,071,032 | 78.6 |
| Trans World | 33,718 | 108,924 | 50.3 | 1,501,090 | ....... | 2,497,352 | 15,173,231 | 50.3 |
| United | 16,746 | 41,643 | 61.1 | 321,973 | 11,325 | 212,861 | 4,800,349 | 49.9 |
| Western | 5,658 | 8,799 | 66.9 | 10,673 | ....... | 19,875 | 940,030 | 54.0 |
| **LOCAL SERVICE** | | | | | | | | |
| Allegheny | 73,578 | 15,342 | 43.0 | 27,215 | 53,424 | 83,489 | 1,629,725 | 47.2 |
| Bonanza | 25,762 | 6,540 | 46.7 | 7,082 | 2,750 | 13,140 | 650,759 | 47.7 |
| Central | 22,593 | 4,333 | 35.1 | 16,298 | 9,207 | 30,206 | 471,098 | 34.3 |
| Frontier | 29,825 | 8,130 | 36.7 | 24,004 | 12,717 | 68,389 | 887,273 | 39.4 |
| Lake Central | 37,734 | 6,133 | 34.3 | 11,676 | 29,337 | 21,117 | 648,938 | 35.5 |
| Mohawk | 74,645 | 15,541 | 44.2 | 26,869 | 35,119 | 53,279 | 1,596,053 | 43.2 |
| North Central | 86,444 | 16,382 | 43.0 | 44,534 | 60,858 | 89,668 | 1,751,422 | 45.0 |
| Ozark | 47,706 | 8,622 | 42.9 | 18,511 | 34,777 | 54,296 | 941,374 | 48.3 |
| Pacific | 36,219 | 8,349 | 49.6 | 17,786 | 4,987 | 9,976 | 830,499 | 50.4 |
| Piedmont | 44,272 | 9,429 | 47.4 | 15,049 | 20,633 | 32,211 | 972,104 | 49.5 |
| Southern | 34,029 | 6,165 | 34.5 | 23,326 | 21,071 | 32,627 | 667,772 | 37.3 |
| Trans-Texas | 26,029 | 6,016 | 35.5 | 20,236 | 11,691 | 48,200 | 665,344 | 38.4 |
| West Coast | 32,957 | 8,092 | 44.6 | 15,515 | 5,990 | 24,040 | 818,331 | 45.1 |
| **HAWAIIAN LINES** | | | | | | | | |
| Aloha | 29,123 | 4,409 | 59.9 | 3,366 | ....... | 4,685 | 361,748 | 51.0 |
| Hawaiian | 41,750 | 6,029 | 60.6 | 4,436 | ....... | 154,058 | 643,397 | 61.0 |
| **CARGO LINES** | | | | | | | | |
| Aerovias Sud Americana | ....... | ....... | .... | ....... | ....... | 248,946 | 248,946 | 64.2 |
| Flying Tiger | 3,387 | 13,805 | 59.8 | 13,263 | 21,940 | 14,582,871 | 15,998,613 | 78.3 |
| Riddle-Domestic | ....... | ....... | .... | 18,986 | 41,067 | 5,404,652 | 5,464,705 | 65.6 |
| Overseas | 7,326 | 34,988 | 93.8 | 4,878 | 710 | 3,895,658 | 7,399,960 | 92.0 |
| Seaboard World | 7,430 | 27,973 | 100.0 | 799,866 | ....... | 4,777,002 | 8,382,209 | 72.7 |
| Slick | 996 | 5,103 | 98.5 | | | 6,162,709 | 6,656,218 | 82.3 |
| **HELICOPTER LINES** | | | | | | | | |
| Chicago Helicopter | 21,292 | 372 | 45.8 | 2,120 | ....... | ....... | 37,634 | 39.2 |
| Los Angeles Airways | 3,070 | 110 | 59.5 | 3,869 | 2,207 | ....... | 16,561 | 67.9 |
| New York Airways | 13,505 | 250 | 50.1 | 1,679 | 984 | 700 | 27,246 | 48.0 |
| **ALASKA LINES** | | | | | | | | |
| Alaska Airlines | 7,334 | 5,760 | 39.0 | 62,586 | 2,615 | 1,209,047 | 1,864,528 | 77.9 |
| Alaska Coastal | 5,604 | 565 | 59.9 | 4,568 | ....... | 6,319 | 68,484 | 64.8 |
| Cordova | 2,808 | 423 | 53.1 | 4,870 | ....... | 68,261 | 116,065 | 57.0 |
| Ellis | 5,502 | 326 | 53.8 | 1,809 | ....... | 3,310 | 41,945 | 62.3 |
| Kodiak | 1,111 | 73 | 35.0 | 457 | ....... | 855 | 9,160 | 30.2 |
| Northern Consolidated | 3,063 | 888 | 40.8 | 50,942 | ....... | 95,279 | 244,539 | 61.3 |
| Pacific Northern | 12,343 | 11,633 | 51.5 | 164,640 | 12,351 | 447,076 | 1,885,128 | 66.4 |
| Reeve Aleutian | 1,327 | 1,250 | 40.7 | 69,819 | ....... | 116,089 | 323,856 | 64.7 |
| Western Alaska | 507 | 26 | 47.0 | 754 | ....... | 1,709 | 4,906 | 45.0 |
| Wein Alaska | 4,402 | 1,348 | 44.2 | 56,441 | ....... | 152,110 | 347,691 | 58.1 |
| Avalon | 9,087 | 388 | 54.5 | 682 | ....... | 366 | 37,847 | 56.0 |

Compiled by Aviation Week from airline reports to the Civil Aeronautics Board.

# AIRLINE OBSERVER

▶ Response to the Senate Commerce Committee's request to foreign flag carriers for comments on international air transport problems has been poor. Some Latin American airlines filed comments, requested by the committee for an investigation of international competitive and bilateral issues, but most of North Atlantic airlines withheld any comment. The chief reason is that the committee did not formally invite foreign carriers to submit comments until Nov. 6, and the deadline was set at Nov. 15, leaving little time for preparation of replies. In addition, several foreign carriers feel that in view of the U. S. drive to curtail foreign competition, any comments submitted might be used against them by U. S. carriers during hearings.

▶ **Trunkline industry load factor of 53.60% for October is a 5.42% drop from that of October, 1960. In the past 12 months, load factor has moved above the 60% mark only once—in June, when it reached 61.14%.**

▶ Soviet Premier Nikita Khrushchev gave short shrift to civil aviation in his lengthy, detailed report to the 22nd Congress of the Soviet Communist Party last month. He mentioned only that Aeroflot was now carrying about 100,000 passengers per day.

▶ **Scheduled international airlines reported a 3.2% increase in passenger traffic and an 11.8% increase in cargo traffic on North Atlantic routes during October, compared with October, 1960. Load factor, during the month, reached 59.2%, highest of any month since October, 1960, when it was 65.1%.**

▶ British West Indian Airways, now owned by the government of Trinidad, has substantially reduced schedules of its subsidiary, Leeward Islands Air Transport (LIAT). Two de Havilland Herons once operated by LIAT now are BWIA flights, including a major one from San Juan to Trinidad via intermediate points. LIAT still operates three Beech Twin Bonanzas on schedules under its own name.

▶ **Sabena's helicopter service may have to be abandoned, or sharply curtailed, if Air Union goes into operation. Under Air Union, Sabena, Air France, Alitalia and Lufthansa eventually would split revenues on a fixed basis. Thus, Sabena's helicopter service, aimed at feeding passengers from European points into Sabena's long-range routes, no longer would be of practical use. Meanwhile, Sabena is delaying a decision on whether to buy a fleet of Sikorsky S-61 or Vertol V-107 helicopters.**

▶ Eastern Air Lines survey of passengers using Air-Bus service between northern cities and Florida show that 17% are first riders and 31% would have used ground transportation if Air-Bus was not available. A total of 52% gave "vacation" as the main purpose of the trip.

▶ **United Air Lines Caravelle services have maintained an average 70% load factor since the twin-jet transport was introduced into scheduled operation July 14.**

▶ Mitsubishi Heavy Industries of Japan is scheduling production under license of 23 Sikorsky HSS-2 military helicopters and seven S-61L helicopter transports. The manufacturer plans to expand production gradually but will probably continue to buy dynamic components from Sikorsky. Nitto Airlines, now operating two S-62 helicopter transports on the Tokyo-Osaka route, is a possible airline customer. Japanese Army and Navy may buy the HSS-2 military helicopter, ordered in the past by the Navy. Reduced seat pitch in the civil version from 34 in. to 29 in. will permit seating with 8 in. knee clearance for 34 passengers instead of 28 passengers in the U. S. version.

▶ **British Parliament last week gave formal approval to United Kingdom participation in Eurocontrol, a joint high altitude traffic control system operated with other European nations. The agreement has already been accepted by France, Belgium, The Netherlands, Luxembourg and West Germany. The United Kingdom government expects its share of Eurocontrol costs would be regained by charges against user airlines.**

# SHORTLINES

▶ **American Airlines** will begin a 5 p.m. nonstop jet flight daily from Los Angeles to New York scheduled to arrive at Idlewild at 12:40 a. m. starting Dec. 1. Service is designed to allow business people a full day in Los Angeles before returning to New York. Times given are local.

▶ **Eastern Air Lines** Dec. 15 will expand its Air-Bus service to include one flight daily between Boston, St. Petersburg and Miami. Tariff filed for the route will be $55.06 Boston-St. Petersburg and $56.90 Boston-Miami.

▶ **Hawaiian Airlines** reports it flew 176,018 passengers during the third quarter of 1961—a 4.4% increase over the same period last year. Total operating revenues were $2.6 million—including $24,098 federal subsidy—for the third quarter of 1961 compared with $2.7 million for the same period last year.

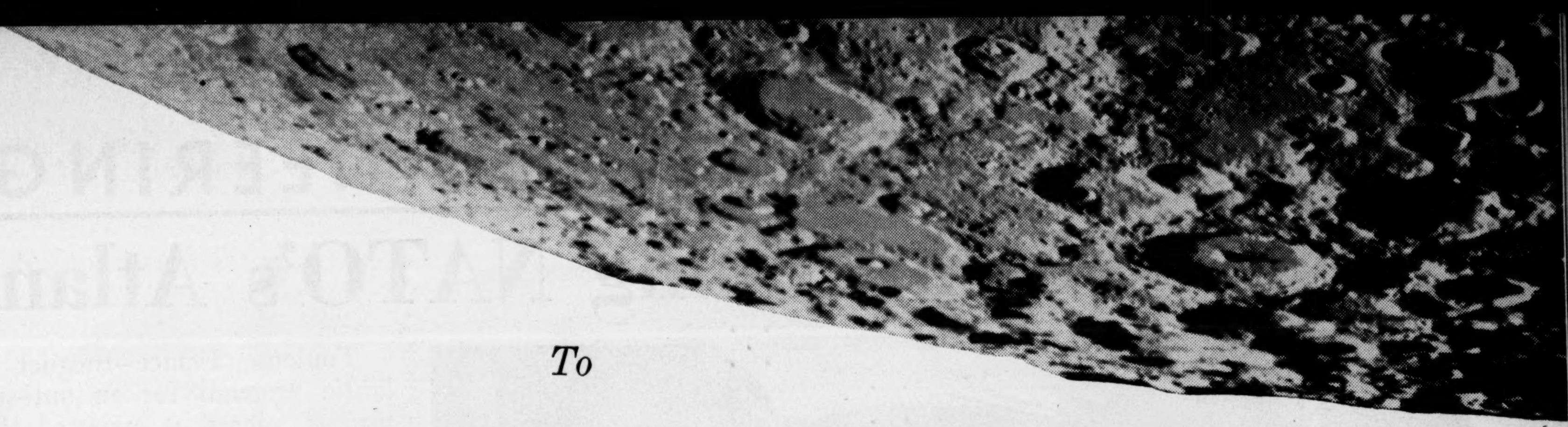
▶ **J. K. Courtney,** assistant vice president-research and planning for Southern Airways, has been named to head the airline's new Administrative Services Department.

▶ **Northeast and Trans World Airlines** have had the time between overhaul for the General Electric CJ-805 turbojet engines powering their Convair 880s increased to 1,400 hr. Delta Air Lines' TBO for the same engine-plane combination has been raised to 1,600 hr.

▶ **Pan American World Airways** has begun 40% reductions in round-trip fares between Europe and the U. S. for military personnel and their families. Fares will be in effect until Apr. 30, 1962. Sample reduction: New York-Frankfurt $337, compared with $561. Groups of 50 or more servicemen traveling between the U. S. and Europe will get even greater reductions, between Dec. 1 and Jan. 31, 1962.

▶ **Rule modification** affecting the speed aircraft may operate near terminal areas is to become effective Dec. 18. Federal Aviation Agency announced that aircraft will have to operate at speeds of less than 250 kt. within 30 mi. of terminals when below 10,000 ft. Present rule is 250 kt. within 50 mi. below 14,500 ft.

▶ **Seaboard World Airlines** reports a net loss of $833,000 for the third quarter this year. Loss compares with a $1.15 million loss for the same period last year. Total revenue for the same 1961 period was $6.5 million compared with $5.1 million in 1960.



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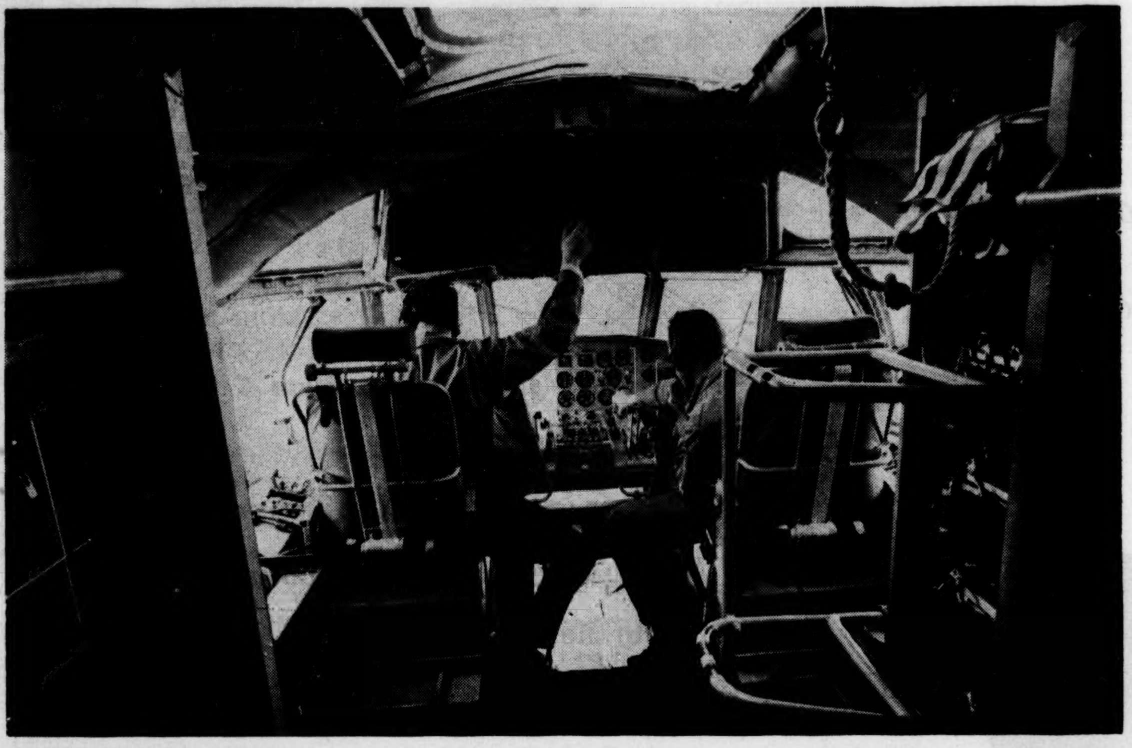
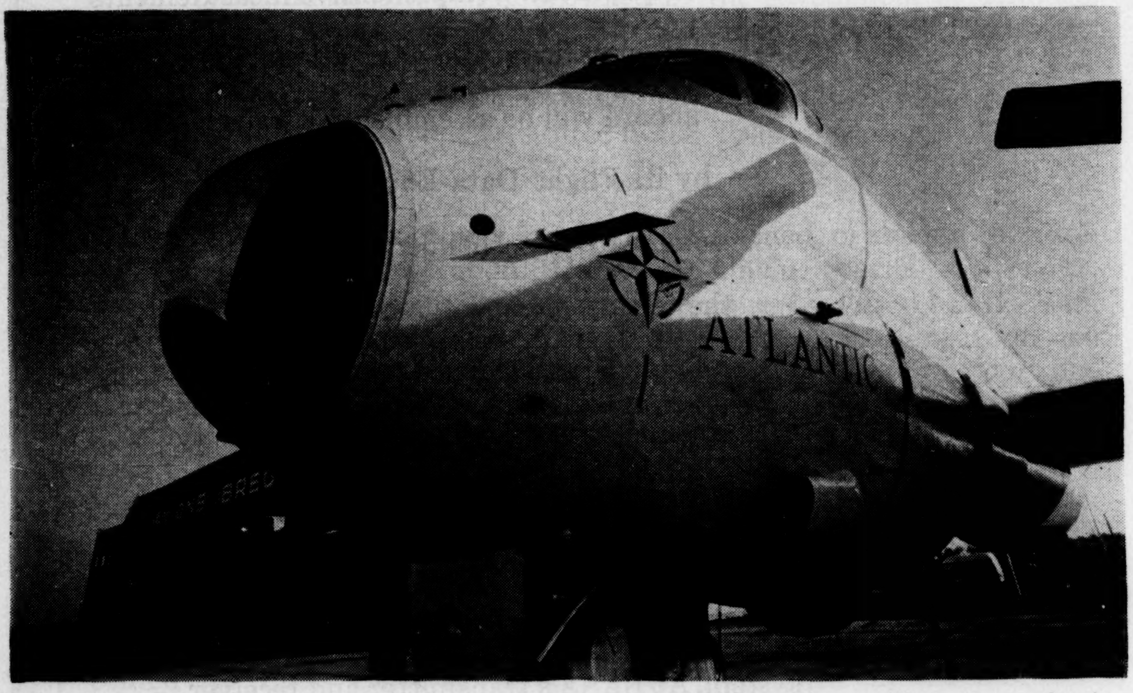
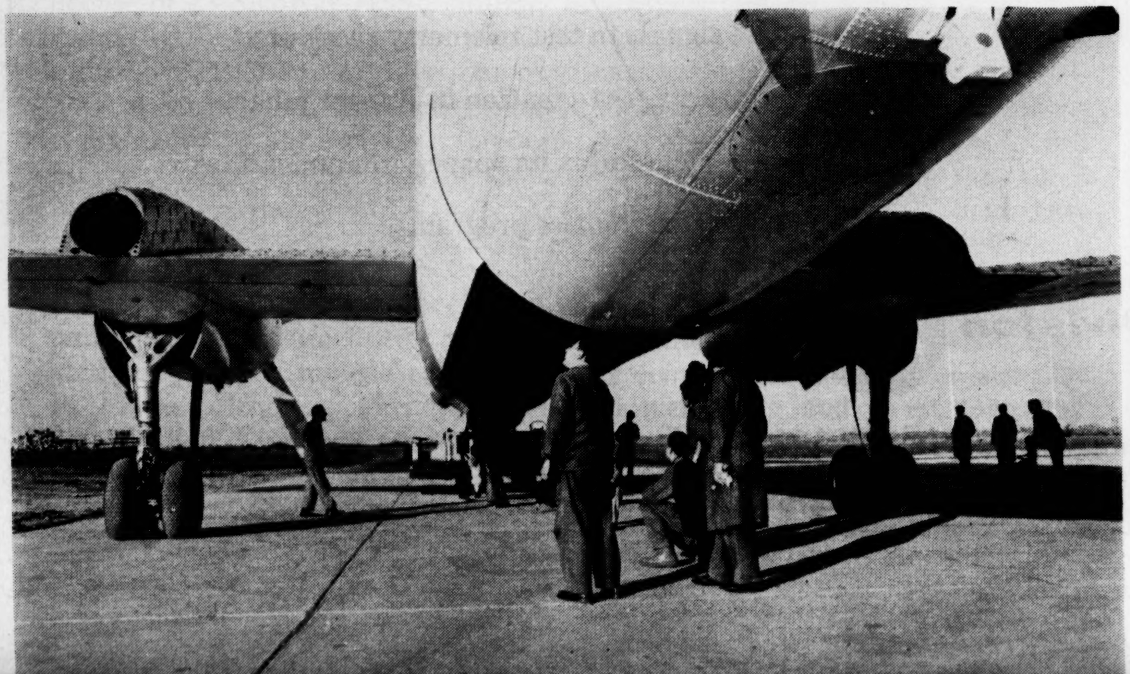
# Breguet Flight-Testing NATO's Atlantic



**BREGUET ATLANTIC** cockpit has not yet had all equipment installed. The anti-submarine warfare aircraft is still only a prototype development program.



**BELLY RADOME** is retracted and weapons bay open in photo above. Nose in production version would be extended about three feet. This is the only major modification contemplated for production aircraft. Photo below shows open weapons bay and wool tufts for testing on upper surfaces of wing and engine nacelles.



**Toulouse, France**—Breguet 1150 Atlantic program for an anti-submarine warfare aircraft, is expected to set the pattern for future joint weapon system development in NATO.

The big twin-Tyne turboprop-powered plane first flew Oct. 21, 10 days ahead of schedule and less than one year after NATO ordered the first prototypes from Avions Breguet, the prime contractor.

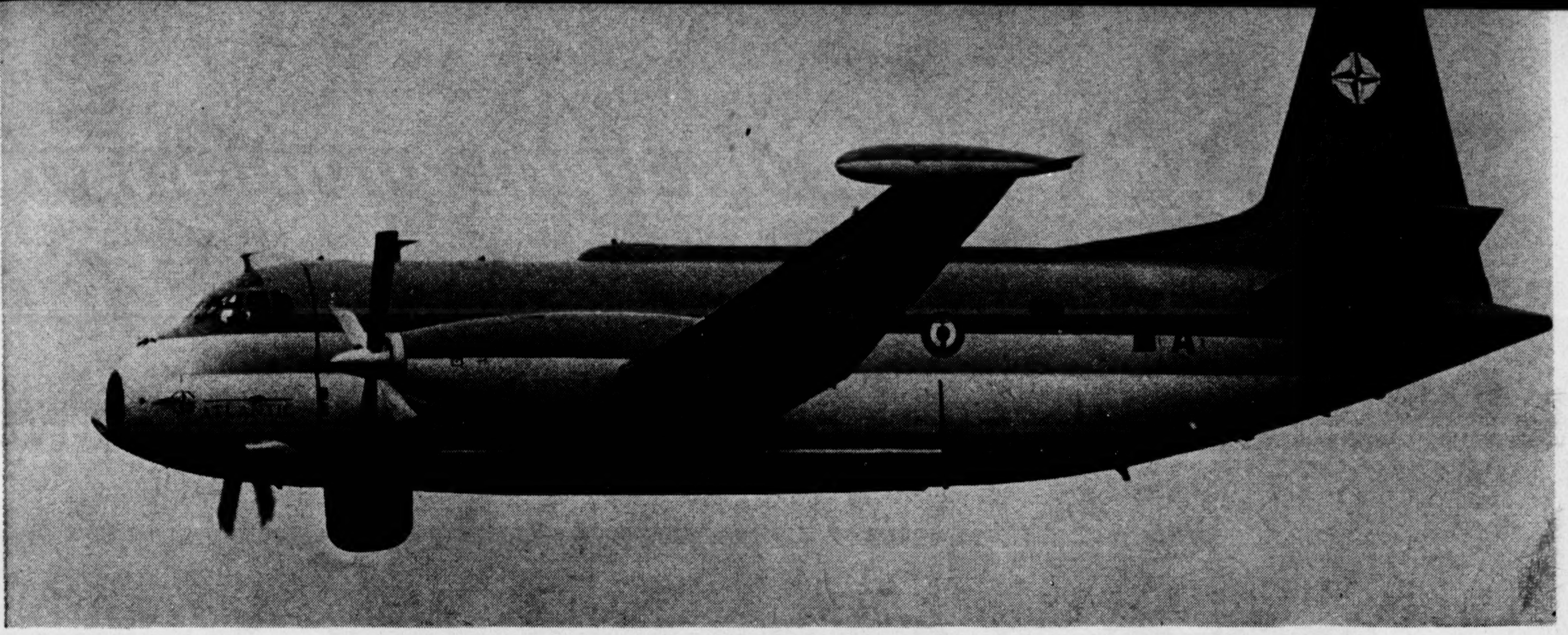
NATO management of the program is through its seven-man Maritime Patrol Aircraft Steering Committee composed of single representatives from Belgium, France, West Germany, Holland and the United States. Permanent vice-chairman of the committee is Henry G. Bloss, head of NATO's aircraft section, and executive secretary of the committee is Isa Woirin, of the same section. Current chairman is French Navy Cdr. Rene Bloch; the position is a rotating one, filled by the national representatives on a cycle of six-month terms.

Atlantic was designed and built by a group of seven companies in four European countries, which have together financed the project with the help of the United States. Designed as a replacement for the aging Lockheed P2V Neptunes, of which about 200 are operational with NATO forces, the Atlantic is still only a prototype development program and no production orders have been placed.

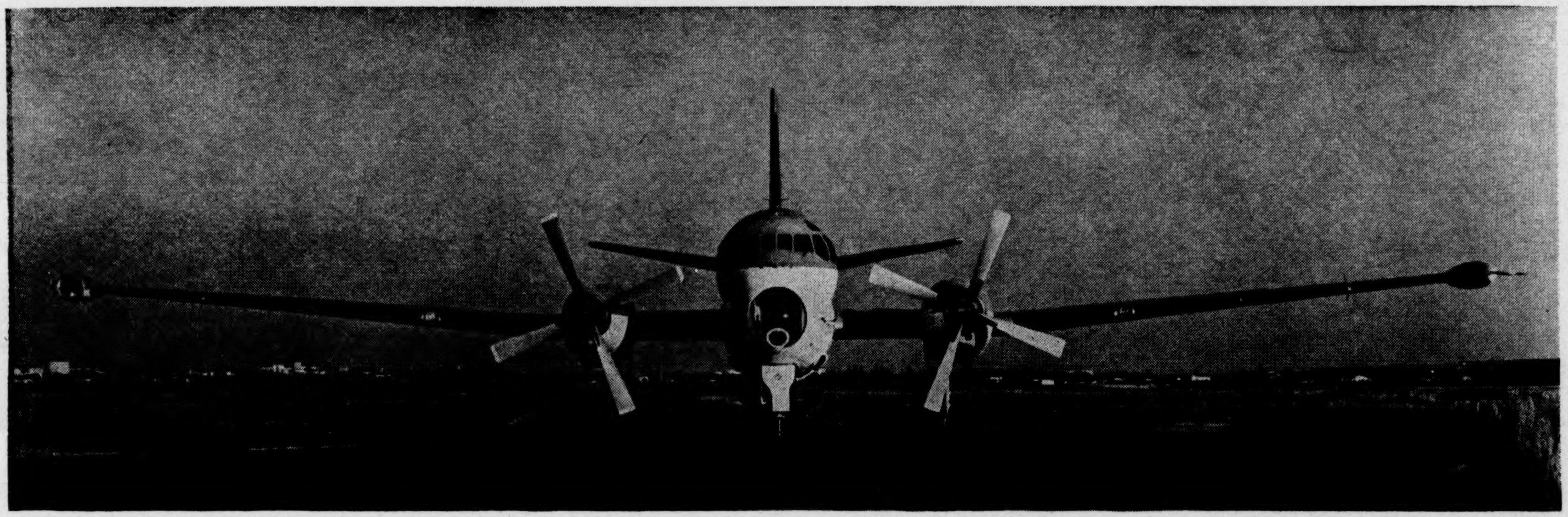
Breguet has scheduled first flight of the second prototype for next February, and the third will follow one year later. Third and fourth prototypes will be pre-production aircraft, with flight-test modifications or any other needed changes incorporated. Already plans have been made to lengthen the third airplane by about three feet. Fourth aircraft, which will be built to production standards, is scheduled to fly in May, 1964.

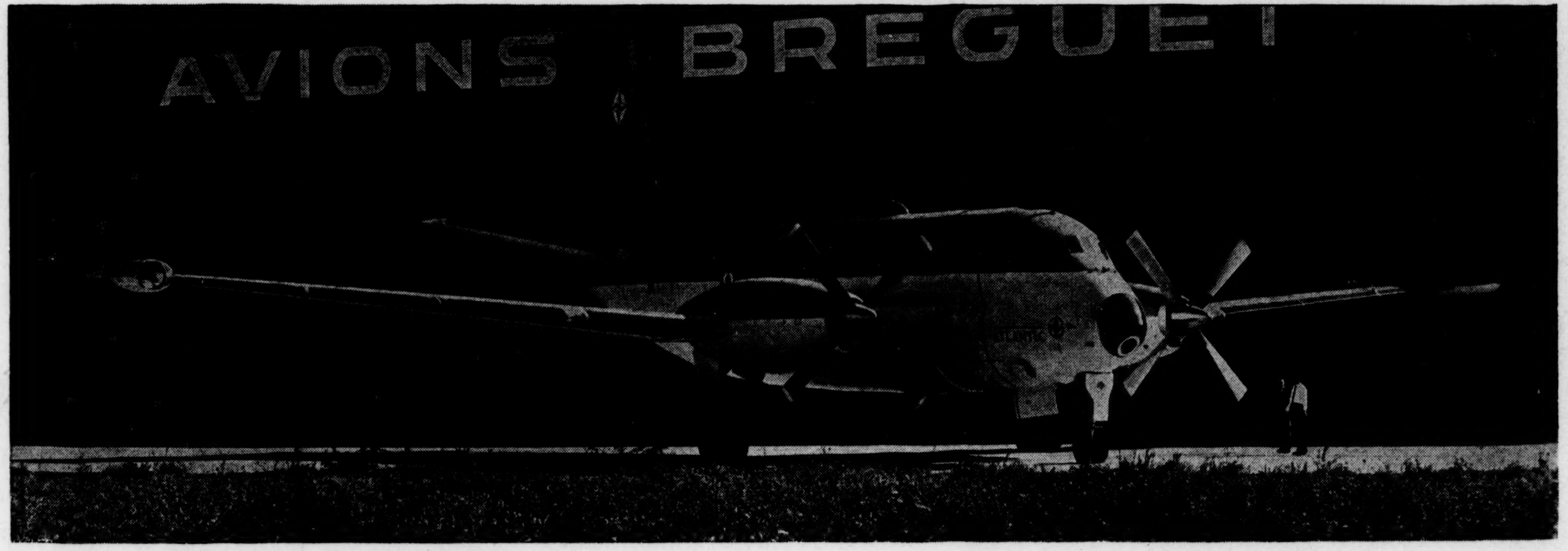
Atlantic has a high aspect ratio wing with a 125-ft. spread and a total area of 1,291 sq. ft. Over-all length of the aircraft is 92.7 ft. and the height is 35.4 ft. The bulging fuselage has a double-bubble cross-section, with the upper lobe pressurized to house pilot compartment, tactical stations and crew quarters. Lower unpressurized lobe contains radar compartment and two large bays. One of the bays is for detection stores—presumably sonar bombs. The other is for weapons, including latest nuclear types. Additional air-to-surface missiles can be carried on wing pylons.

Most of the avionic gear comes from



**DURING** its sixth flight, the Breguet Atlantic flies with one engine feathered and French-designed CSF radar extended.





**WINGSPAN** of Breguet Atlantic is 124.9 ft. Height of the aircraft is 35.4 ft., wheel track is 29.5 ft., fuselage width is 9.5 ft. and fuselage height is 13.1 ft. The two Rolls-Royce Tyne RTy.20 Mk. 21 turboprop engines turn de Havilland Type 4-7000-6 Hydromatic propellers of 16-ft. diameter. Upper lobe of double-bubble fuselage is pressurized.

the United States, but the high-power search radar and some other major installations are European.

Basic mission for the Atlantic is based on a 5,000-mi. patrol range, at a patrol speed of 170 kt. Mission time will vary from 12 to 18 hr. normally.

Maximum gross takeoff weight of the plane is 90,400 lb. Powerplants are twin Rolls-Royce Tyne RTy.20 Mk. 21 turboprops rated at 6,105 ehp. each.

Airframe production and design are the individual responsibilities of a group of seven companies. Breguet, as prime contractor, retained main fuselage design, final assembly and flight testing of the Atlantic. The company also did the preliminary design that won the NATO competition at the end of 1958. But detailed structural design within the loft envelope of the Atlantic's fullsome shape was left to each of the companies participating.

Outer panels are the responsibility of Sud Aviation of France, while the wing center section and engine nacelles are made by Fokker in Holland. Rear fuselage and tail are built by Dornier in Germany. Three Belgian companies—Avions Fairey, SABCA and the Fabrique Nationale d'Armes de Guerre—build the engine frames.

American firms were brought into the competition belatedly after some representatives, making the NATO rounds, found out about the program (AW July 28, 1958, p. 18). None had time to make a careful analysis of specifications and prepare a proposal before the final deadline, their representatives said, except for a fruitless effort by Martin Co. to be named systems manager.

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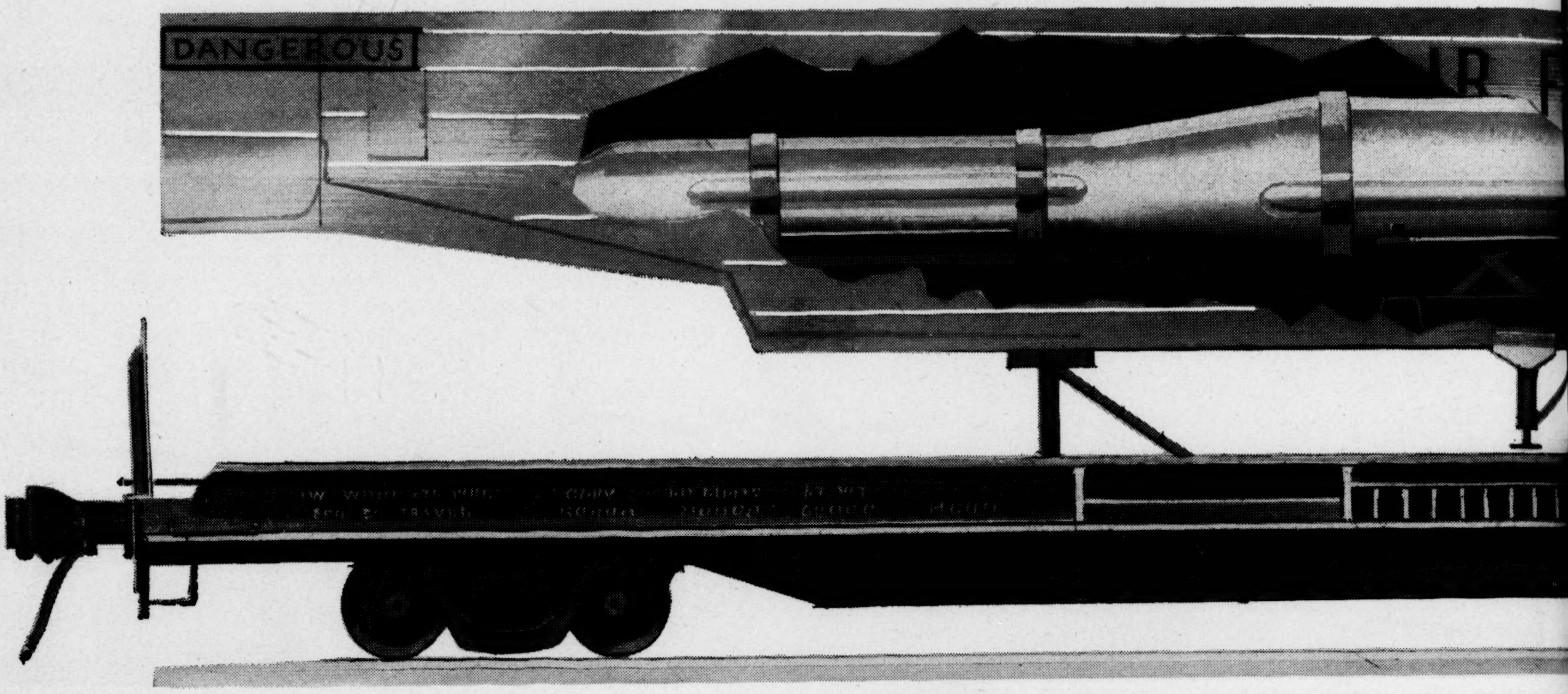

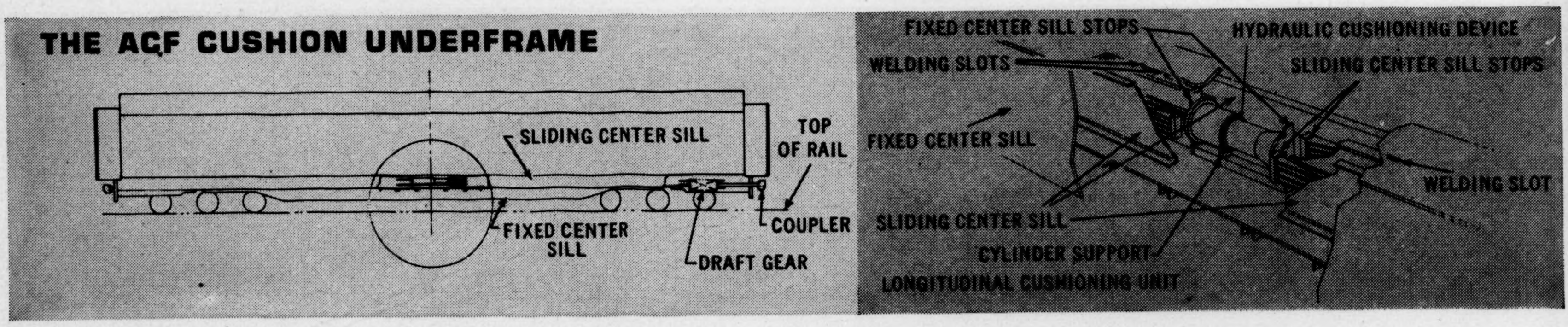
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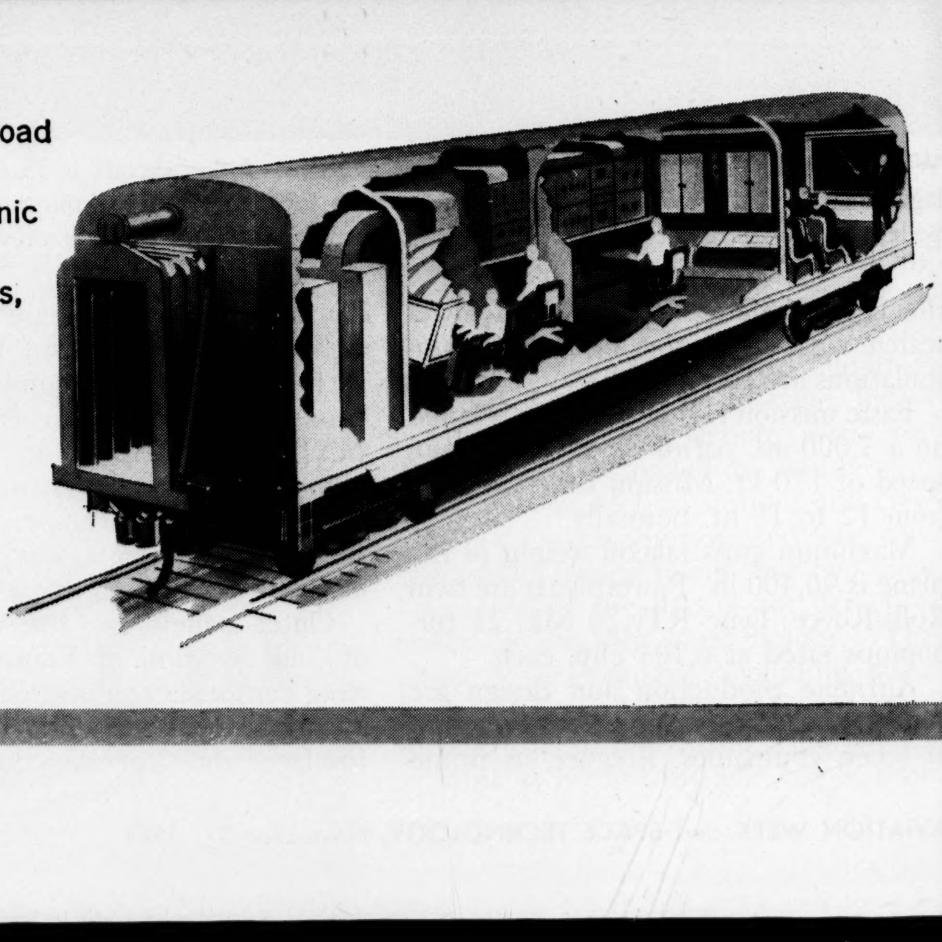

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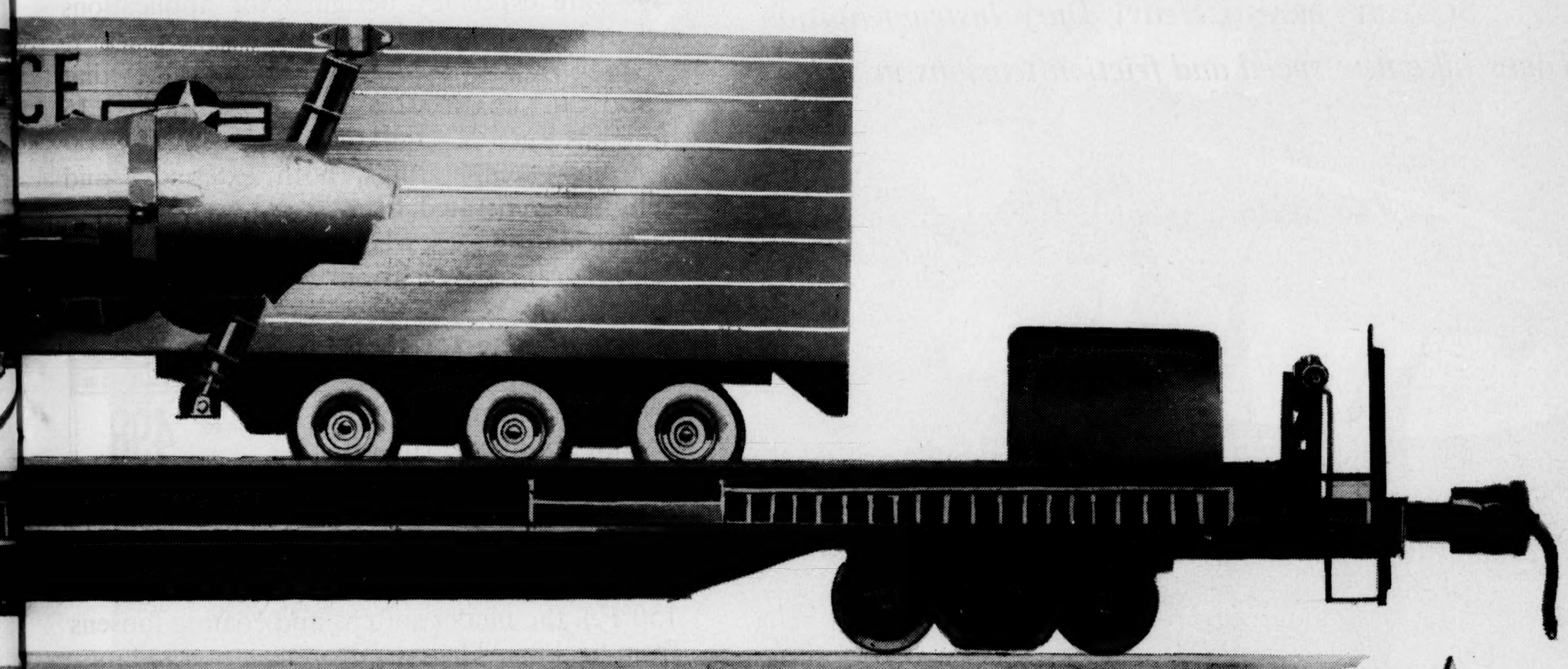
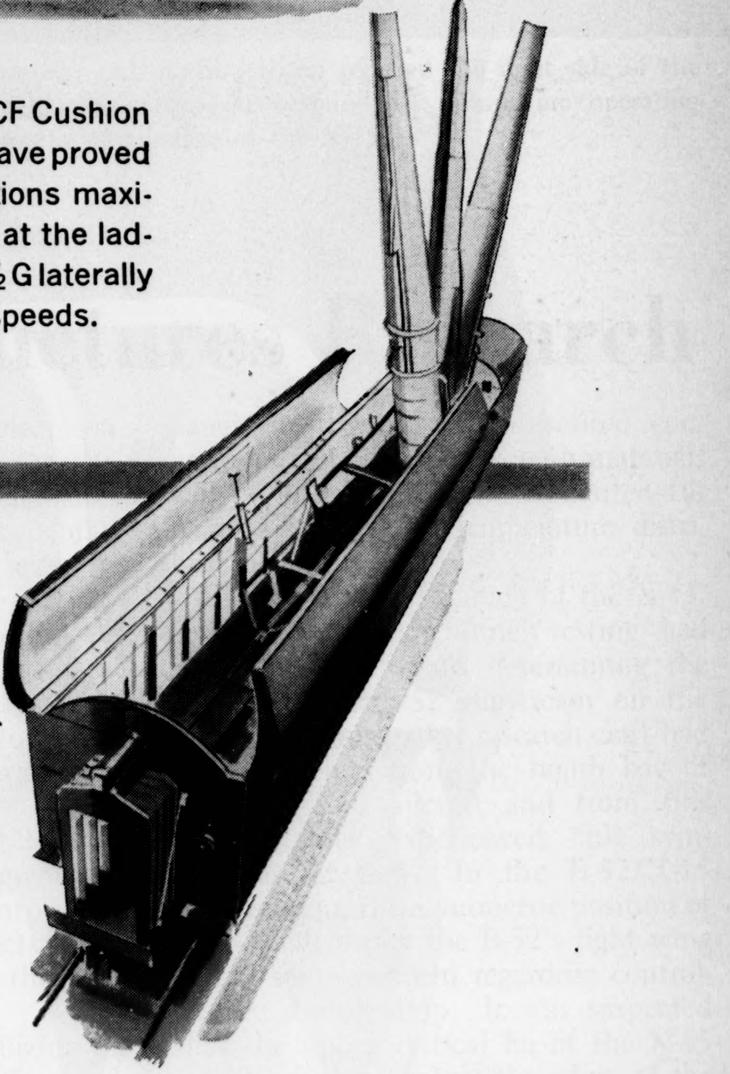
## EQUIPMENT WITH THE ACF CUSHION UNDERFRAME



**MISSILE RAIL TRANSPORTER** This operational flat car offers high-speed, cushioned mobility for transporting missiles, electronic equipment and other extremely large, but shock-sensitive systems. Key to the car's unique shock absorbing characteristics is the ACF Cushion Underframe. Exhaustive tests have proved that under high impact conditions maximum longitudinal acceleration at the lading is less than 2 G's, and only ½ G laterally and vertically at high running speeds.

**MINUTEMAN MOBILE LAUNCHER CAR** ACF's unique Cushion Underframe, applied to a customized railroad car, was a major factor in developing the Mobile Launcher Car. This cushioning device significantly limits the acceleration forces transmitted to the missile during extended rail travel. Tests of the car recorded a maximum acceleration of only .8 G longitudinally at 6 mph impact speed, compared with a shock load of 4 G's on a similar uncushioned car. ACF Industries Incorporated and American Machine and Foundry Company under a subcontract with the Boeing Company developed this car for the United States Air Force.



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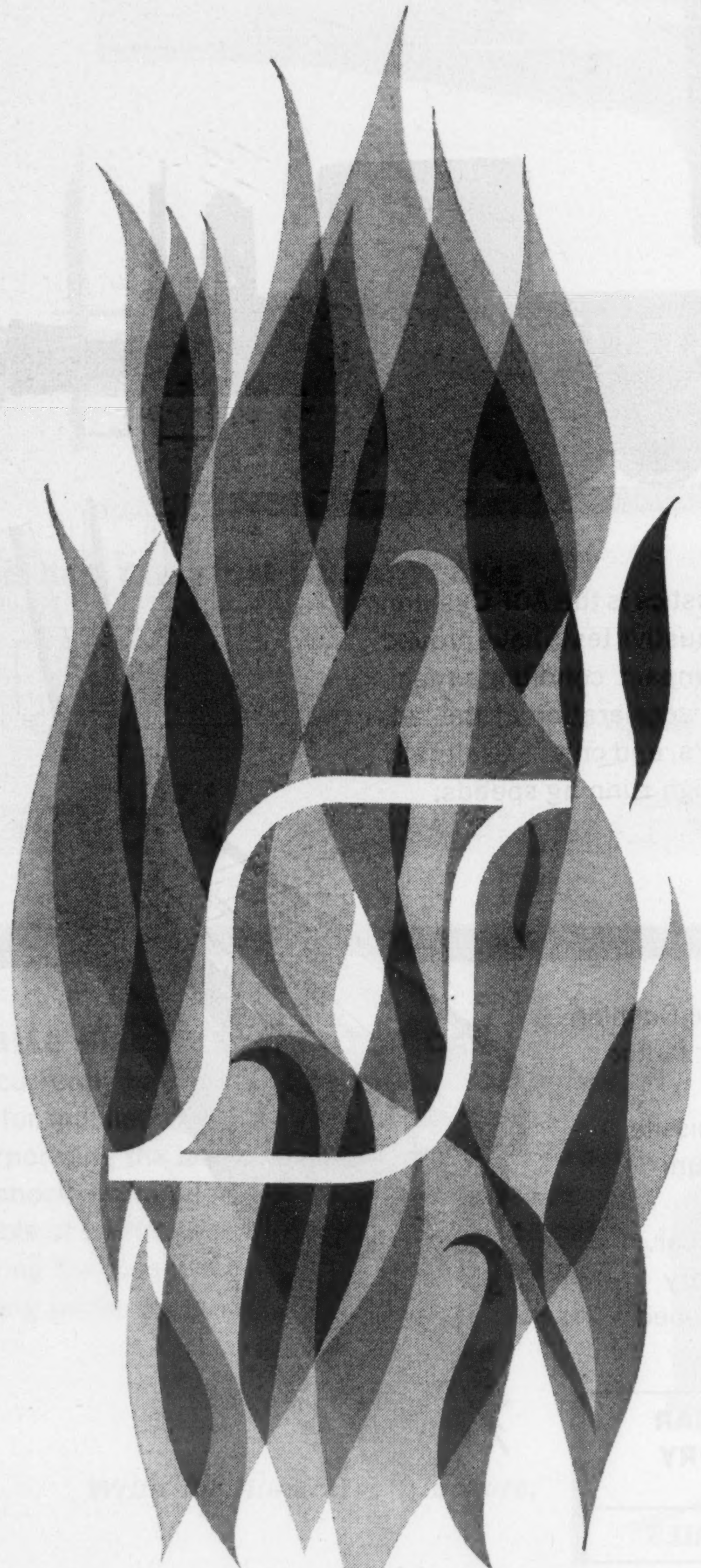
## NEW TAPES TAME DESTRUCTIVE HEAD-HEAT COMPLEX

SCOTCH® BRAND *Heavy Duty Instrumentation Tapes take new speed and friction tensions in stride!*



Today's trend to speed-up in the recording of instrumentation data—with tape speeds up to 120 inches per second—can mean "*Slow Down, Trouble Ahead!*" for tapes that can't cope. On the other hand, "SCOTCH" BRAND Heavy Duty Tapes love to live dangerously—are made for challenging environments where tape speeds are fast and getting faster, where instantaneous temperatures caused by friction between tape and head shoot up. Two new "SCOTCH" Tapes—Heavy Duty Tapes 498 and 499—are especially designed for applications where ordinary tapes soon wear out.

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magnetic tape
INSTRUMENTATION
Magnetic Products Division 3M
498

*They live 15 lives.* Actual field tests show that "SCOTCH" BRAND Heavy Duty Tapes last 15 times as long as standard tapes . . . stoutly resist high temperatures, both externally and internally generated. In instrumentation uses, where tensions caused by friction and heat make tape wear an important factor, these Heavy Duty Tapes preserve the integrity of the coating, minimize rub-off and particle redistribution that separate tape from head . . . and *you* from a signal.

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*At tape-killing paces*—in speeds, tensions, temperatures—we suggest you consider these heavy-duty champions of the tape world: No. 498 and (for extra recording time) No. 499. And for all your needs—in data acquisition, reduction, or control—there is a right "SCOTCH" BRAND tape for the job.

Call your 3M Representative in all major cities . . . he's a helpful guy, a convenient source of supply and information. Consult him for details or write: Magnetic Products Div., 3M Co., St. Paul, Minn.

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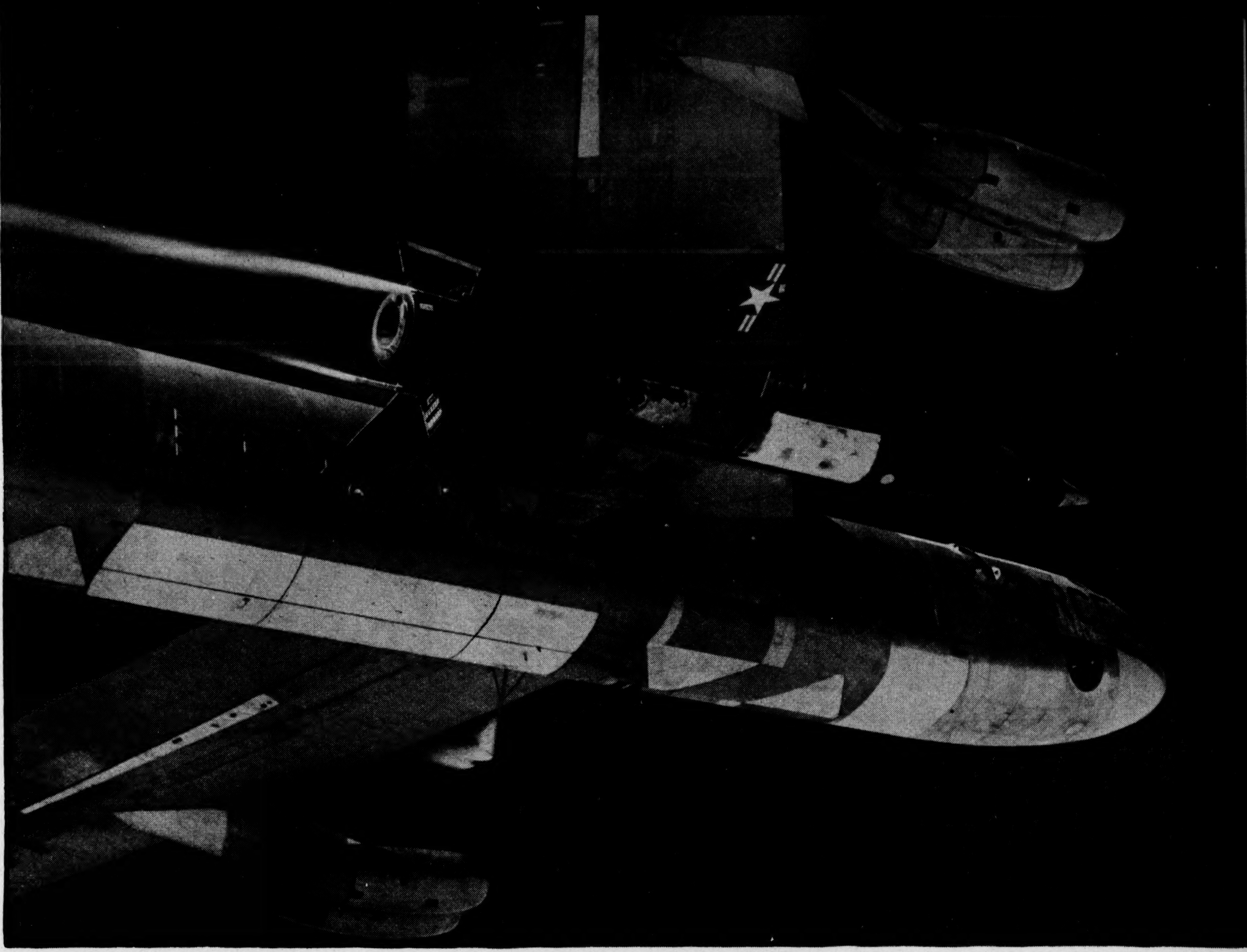


**RECENT PHOTO** of North American X-15 moments before launch shows fuel streaming out of the jettison pipe on the right side of the aircraft while liquid oxygen vents from the left jettison pipe. This is done deliberately to make certain that pumps are operating properly before drop. Note the proximity of the exhaust of number five engine to the empennage of the X-15.

### *North American X-15 Research Program—Part II:*

# X-15 Contributes to Structures Research

By William S. Reed

*(This is the second of two articles on the X-15 research program. The first article (AW Nov. 20, p. 52) described early X-15 research, the vehicle's flight characteristics, control systems and flight profile.)*

**Edwards AFB, Calif.**—Some of the planned X-15 research programs relate directly to the next generation of supersonic aircraft, among them the supersonic transport. Investigations of boundary layer noise and skin friction drag, structural panel tests, and the use of adaptive control systems are among these programs.

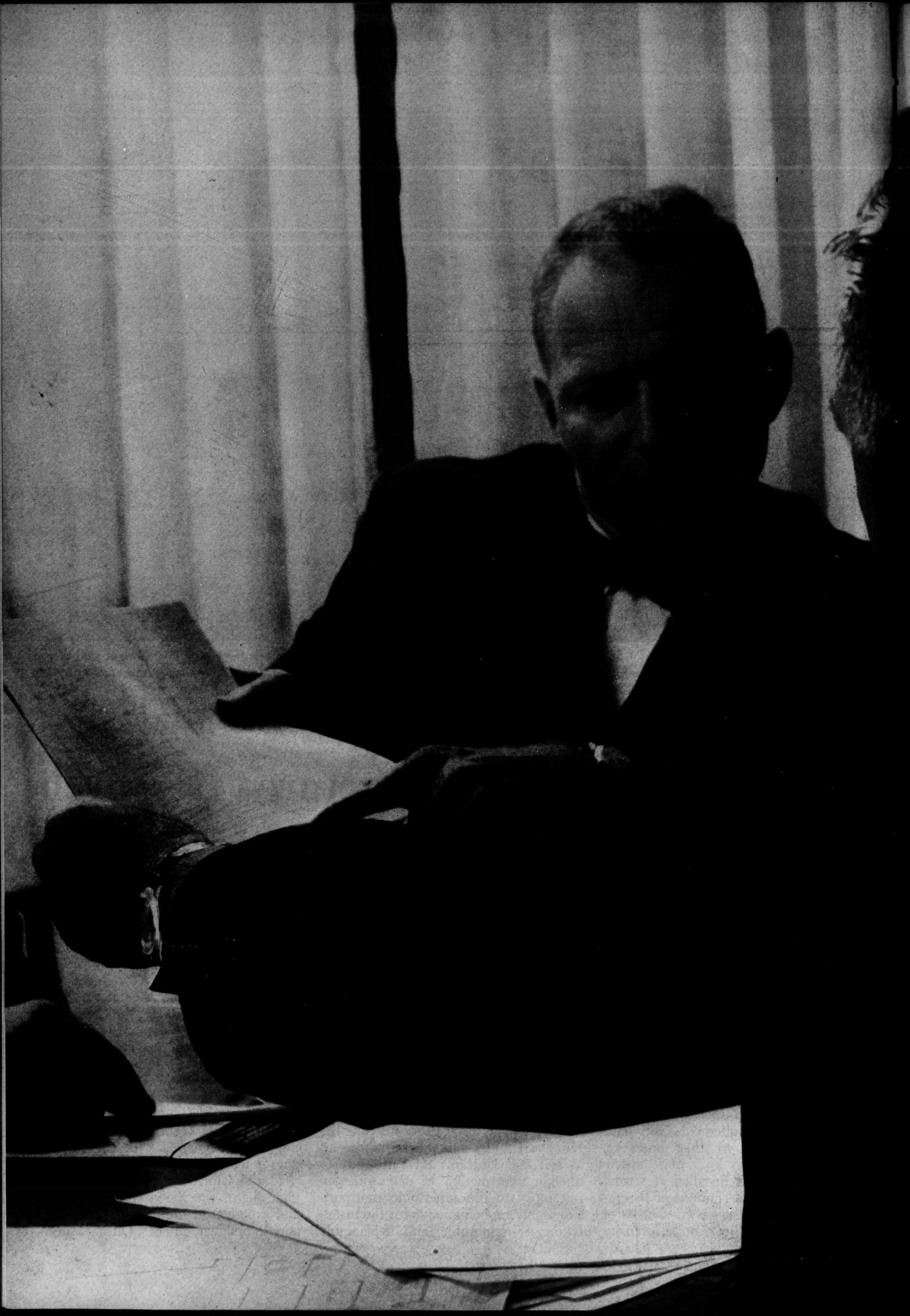
X-15 data on boundary layer noise and insulation requirements will have direct application to the supersonic transport. Boundary layer noise instrumentation is to be installed at several locations on the side fairings of the airplane. The investigation will consist of a correlation of the local noise intensity with the measured boundary layer conditions.

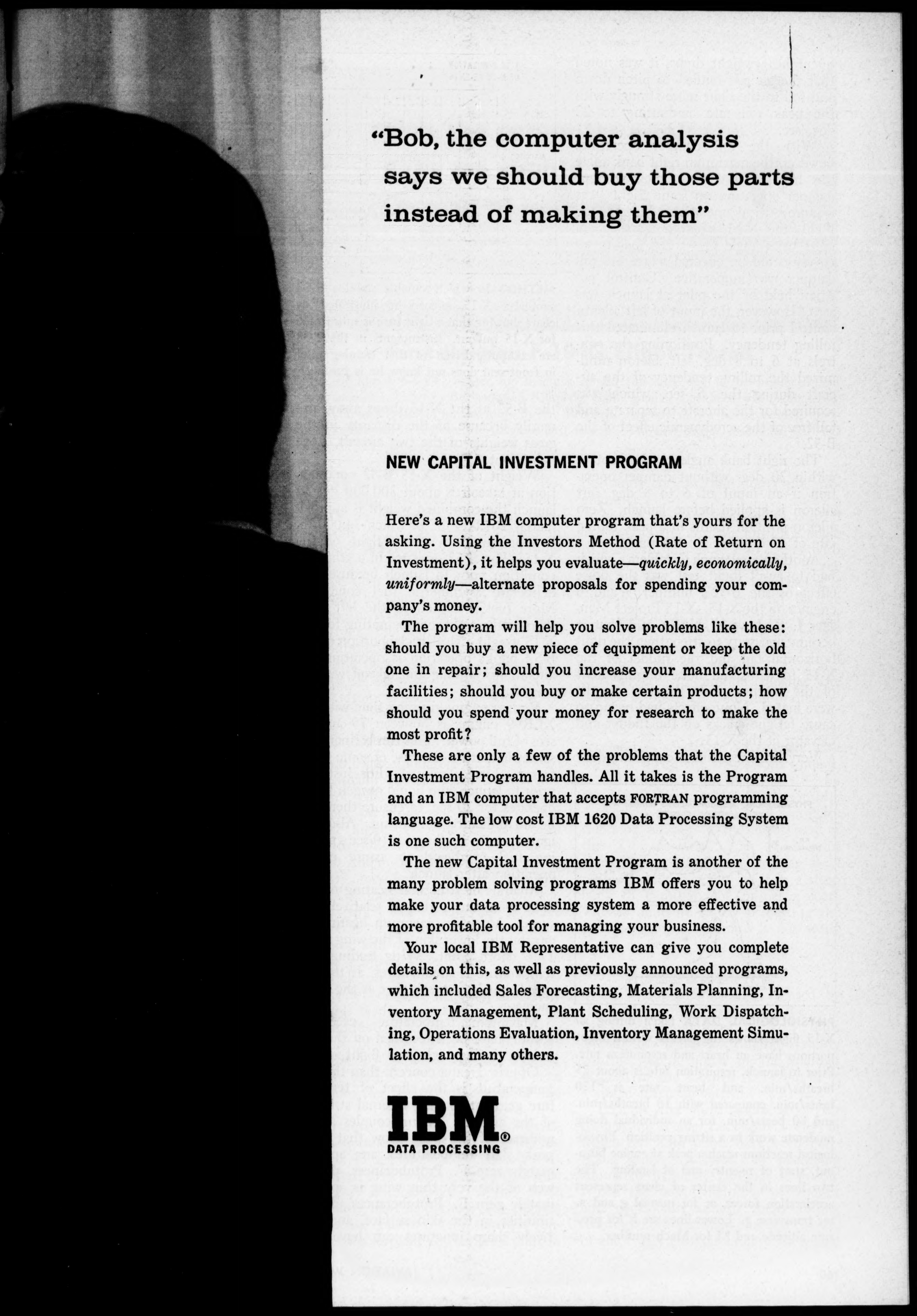
Prediction of lift-drag ratio characteristics and the resulting range capability of a particular configuration early in the design stage will also be of vital interest to the airplane designer. Although base drag measurements on the X-15 have compared favorably with the wind tunnel predictions, the total drag calculated from flight data was more than that predicted from wind tunnel tests. In an attempt to understand better the cause of this disagreement, skin friction drag measurements are to be made to determine the effects of the skin friction components on the total drag.

Future plans also call for utilizing the lower vertical fin and side fairing panels as test bed locations for various types of skin construction to determine applicability to the supersonic transport. Provisions are being made for the installation of removable and replaceable panels in these areas. Structural configurations such as honeycomb materials will be installed and instrumented for panel response and temperature distributions.

Prior to the first launch of the X-15, considerable wind tunnel testing had been directed toward determining the effects of the B-52 slipstream on the X-15. Previous rocket research craft had been launched from the bomb bay of B-29 or B-50 aircraft and from this position they experienced only symmetrical air flow. In the B-52/X-15 combination, the asymmetric position of the aircraft under the B-52's right wing led to some concern regarding controllability during drop. It was suspected that the upper vertical fin of the X-15 might possibly contact the edges of the cutout in the B-52 flap.

During launch for the first unpowered glide flight, the X-15 separated cleanly and experienced the predicted right roll and nosedown pitch. During subse-





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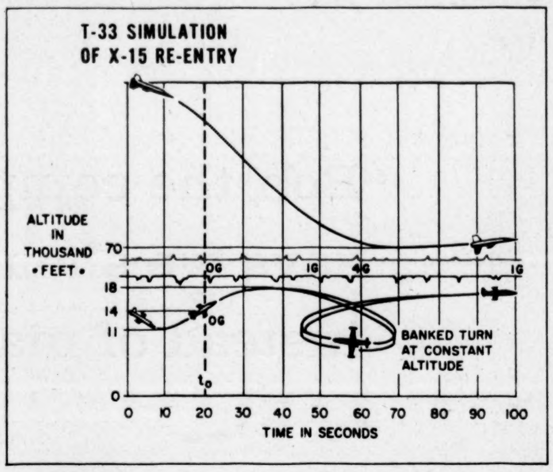
quent heavyweight drops, it was noted that the aircraft tended to pitch down and roll to the right more strongly with the peak roll rate amounting to 22 deg./sec.

With the roll damper operating, however, the maximum right bank angle was held to 9 deg. Launch without damper operation on some flights was a more critical operation. During one flight, the X-15 achieved a maximum right bank angle of 40 deg. before recovery could be effected when the roll damper was inoperative. Control position held by the pilot at launch was zero. However, the input of left aileron control prior to launch eliminated this rolling tendency. Positioning the controls at 6 to 8 deg. left aileron minimized the rolling tendency of the aircraft during the .8 sec. which was required for the aircraft to separate and fall free of the aerodynamic effect of the B-52.

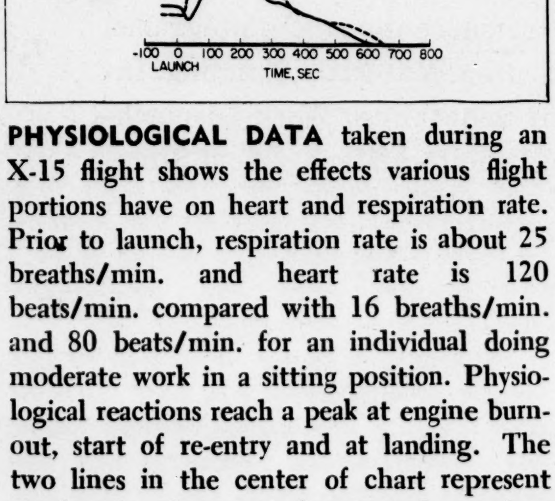
The right bank angle can be kept to within 20 deg. without damper operation if an input of 6 to 8 deg. left aileron is applied before launch. Zero aileron position results in a peak rolling rate of 47 deg./sec. to the right.

Another prelaunch problem which had to await flight test was the noise effect of the B-52's number 5 and 6 engines on the X-15. X-15 Project Manager J. E. Love of NASA said that it became necessary to strengthen the right horizontal tail and the rudder of the X-15 to withstand noise impingement of the engines while the two aircraft were mated. Noise effects had begun to cause fatigue cracks on the rudder and elevator of the X-15.

Very little reaction is experienced by the B-52 as the X-15 drops away, primarily because of the disparity in the gross weights of the two aircraft, Love points out.



**METHOD** by which variable stability T-33 simulates X-15 re-entry is illustrated by chart showing that a tight turn is substituted for X-15 pullout. Instruments in the T-33 are computer-driven so that training pilot in front seat does not know he is turning.



**PHYSIOLOGICAL DATA** taken during an X-15 flight shows the effects various flight portions have on heart and respiration rate. Prior to launch, respiration rate is about 25 breaths/min. and heart rate is 120 beats/min. compared with 16 breaths/min. and 80 beats/min. for an individual doing moderate work in a sitting position. Physiological reactions reach a peak at engine burnout, start of re-entry and at landing. The two lines in the center of chart represent acceleration forces, $a_z$ for normal g and $a_x$ for transverse g. Lower lines are h for pressure altitude and M for Mach number.

Weight of the X-15/B-52 combination at takeoff is about 300,000 lb. At launch the combined weight is approximately 261,000 lb., of which 34,000 lb. is represented by the weight of the X-15. The B-52 operates in a trimmed condition prior to launch because of a deliberate asymmetric fuel condition. More fuel is carried in the left wing than in the right, compensating for the X-15 weight. Most tricky portion of the B-52 pilot's operation is operating the aircraft for landing and takeoff without wing flaps.

Present engine running time with the XLR99 engine is between 79 and 82 sec. of full power. This can be increased somewhat, at the expense of some safety factors, Love disclosed. For instance, prior to launch, the liquid oxygen pump operates for 20 sec. to ensure there will be no difficulty in starting. Also, the igniter pump is idling for 10 sec., pumping fuel overboard to assure engine operation after launch.

Analysis of structural heating on the X-15 wing shows that at relatively low speeds, Mach 3, maximum heating occurs on the lower skin of the wing at the 17% chord point. Wing leading edge temperature is much lower, at the low speed, but becomes higher as the speed increases.

Maximum temperatures exceeding 1,400F have been recorded on the ventral fin during highspeed flight.

Of even greater concern than the skin temperature is the effect of temperature gradients on the internal structure of the aircraft. Thermocouples at the midspan of the wing show that when peak skin temperatures are approximately zero F. Protuberances, discon- web of the very thin wing is approximately zero F. Protuberances, discontinuities in the skin surface, and relatively sharp junctures can have large effects on temperature. Temperature-sensitive paints have been applied to local areas on the X-15 to illustrate graphically how these protuberances affect skin heating. The backup structure beneath the skin acts as a heat sink and drains away heat, keeping the skin cooler in these areas, whereas unsupported skin areas are free to heat.

In particular, heat builds to a maximum on the leading edge of the wing where expansion joints in the leading edge are located. Because of the high temperatures which have been encountered in these areas, inter-rivet buckling of the skin immediately behind several of the expansion joints has been found. The wing leading edge has been modified to incorporate fairings over the expansion joints which serve to eliminate the heat buildup in these areas. A photograph of the temperature sensitive paint shows graphically where internal structure acts as a heat sink and where maximum heat is built up at wing leading edge discontinuities.

Panel flutter is of concern on some of the thin unsupported skin areas on the X-15 fuselage. Considerable effort is being expended to predict panel flutter but more emphasis is needed in determining the influence of temperature, flow angularity, and panel effective stiffness. Strain gages mounted on a fuselage side fairing showed a large increase in output at a dynamic pressure of about 600 psf. and a Mach number of approximately 2.5. The panels are stiffened with corrugations oriented perpendicular to the airstream and attached to the intersurface. To correct this, "hat" section stiffeners were riveted to the inner corrugations oriented in the direction of the airstream.

Subsequent tests on the panels which were stiffened by the "hat" sections gave greatly reduced strain indications and no evidence of flutter. Considerable interest in panel flutter has been generated by X-15 flight tests as one more by-product of the research program.

Stability augmentation systems in the X-15 have presented two problems, the first being a residual oscillation, or limit cycle, resulting from free play in the control system and the second which is a structural augmentation system interaction. The first has caused undesirable low frequency oscillations of the airplane at high system gain settings and high control effectiveness.

The airplane motions from the limit cycle have not been found to be objectionable by the pilots, however. The second problem has caused violent oscillations of the aircraft in flight with high system-gain settings. These oscillations can seriously affect the operation of the vehicle and may cause structural failures.

This structural-feedback problem is caused by rapid control surface deflec-

### First Belgian F-104G Flight-Tested

**First Lockheed F-104G fighter for Belgium is also the only one to be produced and assembled at Lockheed's Burbank and Palmdale, Calif., plants. Lockheed will manufacture 14 additional F-104Gs for assembly by the Belgians. Aircraft shown here touching down at Palmdale will be delivered to Belgium next month. The first Belgian-assembled F-104 G is expected to be completed in early 1962.**

tions which excite vibrations in the control surface structure at the natural frequency of the surface. These oscillations are low-damped and are sensed by the rate gyros in the augmentation system which, in turn, feed the signals back into the control system. This produces a violent oscillation of the entire airplane occurring at the natural structural frequency of the control surface.

To prevent the occurrence of this phenomenon, close attention is required to placement of rate gyros in the fuselage so that they are least sensitive to structural vibrations.

## Filters Used

Also suitable filters in the augmentation system are introduced to reduce gains at the structural frequencies which could induce large oscillations in the system. Experience to date, although generally satisfactory, emphasizes the necessity of close inspection of servicing operations and well-planned checkout techniques on the augmentation system because of a number of failures.

Slightly less than one-third of the flights have been flown with various axes of the stability augmentation system either completely or intermittently inoperative. And in some cases, flights were undertaken even though the augmentation system was known to be malfunctioning prior to flight. Failures were found to be primarily a result of electrical wiring problems with additional failures in the electronic packages in the manual gain-setting switch assemblies.

The X-15 has experienced a number of cabin pressure failures during recent high altitude flights. The environmental system for the aircraft utilizes insulation as partial protection against high temperatures with gaseous nitrogen being supplied by a temperature demand system to control temperatures and pressure in the pilot's compartment and in the electronic equipment bay. An investigation of the failures revealed that the cabin ambient temperature, especially in the area of the temperature control units, fell so low during prelaunch operations that the demand for additional liquid nitrogen to maintain a specific temperature was lower than predicted. Thus, the additional gaseous nitrogen previously relied on to assist and maintain a cockpit altitude at the specified value of 35,000 ft. was not available.

This problem is being eliminated by providing a supplemental pressure control means of injecting liquid nitrogen into the cockpit.

Several forms of simulation have been used in the X-15 program, primarily aimed at familiarizing the pilots with the re-entry characteristics and landing performance of the X-15. Because flight durations are very short, usually on the order of 10 min., considerable effort has been expended in building simulators for use as training tools.

One such simulator is a control system and cockpit mockup at the North American Aviation plant in Inglewood. Control system movements are fed into a computer which integrates these inputs and then drives the cockpit instruments to simulate a complete X-15 flight from launch to landing (AW Oct. 17, 1960, cover).

## Other Simulators

Two other simulators have been used to acquaint pilots with stability and control effectiveness in certain flight regimes, principally the re-entry portion of the flight. Two aircraft have been used for this—a Lockheed T-33 and a North American F-100.

T-33, modified by Cornell Aeronautical Laboratory, features variable stability which can be engaged to make the T-33 fly with the same control response and effectiveness as the X-15. Either a sidestick controller or the center stick can be utilized by the evaluation pilot in a front cockpit. These controls feed inputs to servos through a computer mechanism which alters the stability of the T-33 to make it handle like the X-15.

One example of such a mission is to simulate the re-entry maneuver of the X-15.

To start, the T-33 dives to maximum permissible speed before pulling up to a 45 deg. angle. The aircraft then is pushed over to zero g and a parabolic trajectory is established. At this point the safety pilot in the rear seat engages the special control system, transfers control of the airplane to the X-15 pilot in the front cockpit, and starts the programmer.

The X-15 pilot then takes control and rotates the airplane until the angle of attack displayed to him agrees with the specified re-entry angle of attack of the X-15. The T-33 load factor is increased during the rotation by the same amount as the X-15—0.2 g. Proper relationship between the displayed angle of attack and load factor is maintained by the programmer.

Reference to motion outside the cockpit is obscured from the evaluation pilot by a hood. By following the prescribed angle of attack and normal acceleration scheduled for re-entry with wings level on the display instrument, he will automatically keep the T-33 on the specified speed-altitude relationship. A banked turn in the T-33 simulates the long pullout in the latter part of the X-15 re-entry. The X-15 pilot thinks he is performing a wings-level pullout while in reality he is in a steep bank to maintain the proper g load. This is done by slowly precessing the attitude gyro so the pilot is not aware of the motion.

## Control System Response

F-100 Super Saber also is used by the X-15 pilots to reproduce the control system response of the X-15. This aircraft also features a variable stability control system much in the manner utilized in the Cornell T-33 but it is a single place aircraft.

Perhaps the most useful tool for simulation is the Lockheed F-104 in which the X-15 pilots have been practicing landing patterns. By practicing simulated flameout landings with the F-104 the pilots maintain proficiency and continually refresh their landing technique. It is perhaps through the use of the F-104 that pilots have been able

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(OFFICIAL U. S. AIR FORCE PHOTOS)

# NICE CATCH!

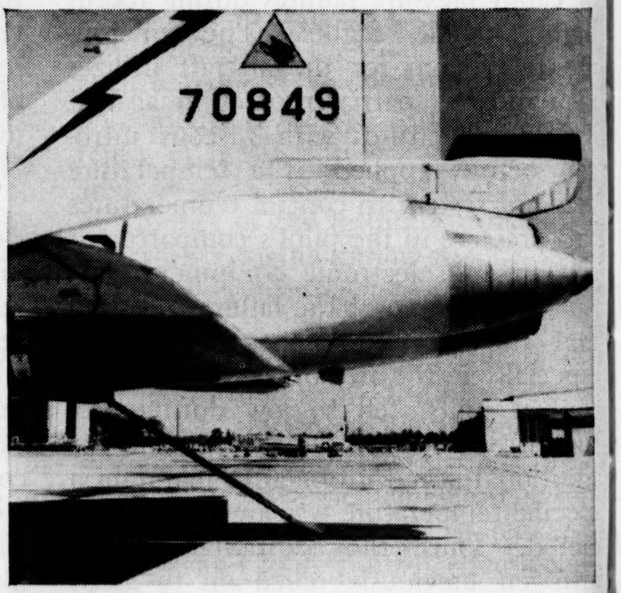
This F-106 is participating in one of a series of tests of the BAK-9 overrun barrier installation at Seymour Johnson Air Force Base, Goldsboro, North Carolina.

As a matter of fact this particular barrier has already figured in a genuine emergency: an F-102 came in on a "deferred emergency" and its drag chute failed to deploy. But, despite the fact that the aircraft was unusually heavy with fuel, an engagement twenty feet off-center with the BAK-9 brought it to a safe, smooth stop within the overrun area.

The fact that such "catches" are possible is a tribute to the dedicated group of Air Force men who have made aircraft and pilot safety their mission.

Bliss, as developer of the BAK-9 barriers now being installed at Air Force Bases around the world, is proud to be associated with these men... proud to do its bit in helping make the U.S. Air Force second to none in safety.

**How overrun barriers work . . .** recently published bulletins describe principle of operation. They're yours for the asking.



*CLOSE-UP shows typical arresting hook used on Century fighters. Bliss BAK-9 and other barriers were developed and tested at the company's Woodbine, N. J. test facilities.*

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to land the X-15 with such remarkable accuracy. In the final analysis, however, it is the actual practice with the X-15 that leads to proficiency. The aircraft used in the simulation program, F-104, F-100, and T-33 are all valuable tools because dynamic response is available.

### USAF Support

Air Force Test Center's support of the X-15 flights now is supplied much as a matter of routine but still encompasses a significant effort. For a typical flight such as those recently made in expansion of the performance envelope, Air Force X-15 Flight Test Project Officer Richard J. Harer points out some of the personnel and equipment involved:

- **Support aircraft.** In addition to the X-15 and B-52, 10 other aircraft with crews are required for each mission: One F-104D, two F-104As and one F-100F for chase during the flight duration of the mission; two C-130As, one C-54 and three H-21s for equipment and personnel transport and rescue. One C-130 and the H-21s are airborne in the vicinity of the emergency landing areas with a doctor aboard one H-21 and two paramedics aboard the C-130. Their orbit points are such that they are no farther than ten minutes from the scene of a crash.
- **Support vehicles.** Fire trucks are located at the launch point, two intermediate lakes and at Edwards. The fire trucks at other than Edwards are airlifted to the emergency sites the day before the flight. Total number usually is two at launch site, one at each intermediate site and two at Edwards. Other equipment is required in the form of nitrogen trucks and radio equipped vehicles.
- **Support personnel.** Fire trucks are manned by a total of 24 firemen. NASA and the Air Force also provide X-15 specialists and crew chiefs at all sites plus pressure suit specialists to assist the pilot.

Contact must be maintained between the various vehicles and aircraft at the emergency sites and all must be in position by launch time. Should one fail to be ready at the proper time, substitutions must be made and areas of responsibility shifted at the last minute.

One example of last minute substitution took place on the altitude flight made by White Oct. 17. NASA's John B. McKay was scheduled to fly an F-104 chase aircraft but mechanical difficulty developed at the last moment and he was unable to take off as planned. He raced to the NASA hangar where an A4D was readied and he made a takeoff crosswise on the dry lake only minutes behind his original schedule. McKay managed to slide into position with no time to spare at the proper point.

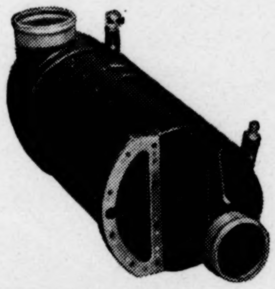
Coordination also must be maintained with the Federal Aviation Agency, Harer says, to preclude interference among the X-15 and support aircraft and any air traffic along V-21 airway. This is sometimes difficult especially when delays cause the expected takeoff time to slip. In addition, all local traffic from Edwards and adjacent fields must be kept out of the area to minimize interference with chase aircraft or the X-15 itself. Warning also must be provided to adjacent U. S. Army Nike sites whose search and tracking radar cause interference with the doppler navigation gear aboard the B-52 making precise location of the launch spot quite difficult.

## PRODUCTION BRIEFING

**Hallicrafters Co.** of Chicago will provide communications equipment for Boeing B-52 bombers under two Air Force contracts totaling more than $8.3 million.

**United Electrodynamics, Inc.**, Pasadena, Calif., will construct a seismic observatory in Tonto National Forest, 90 mi. northeast of Phoenix, as part of Project Vela, under direction of the Advanced Research Projects Agency of the Department of Defense. The observatory is intended to provide improved means of detecting and identify-

A REPUTATION BUILT ON SERVICE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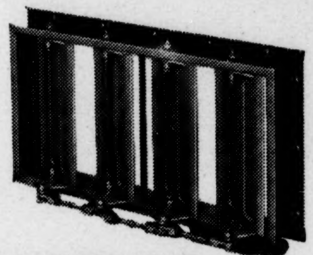
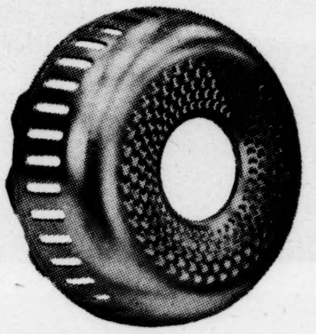
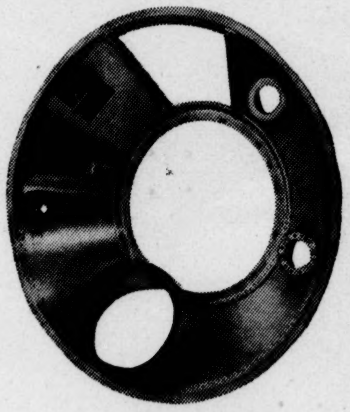
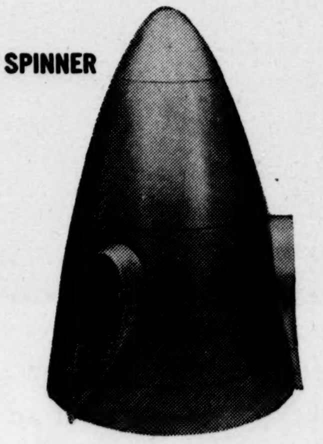

LOUVER VALVE


SWIRL SHELL


ACCESS DOOR

AIRCRAFT DOOR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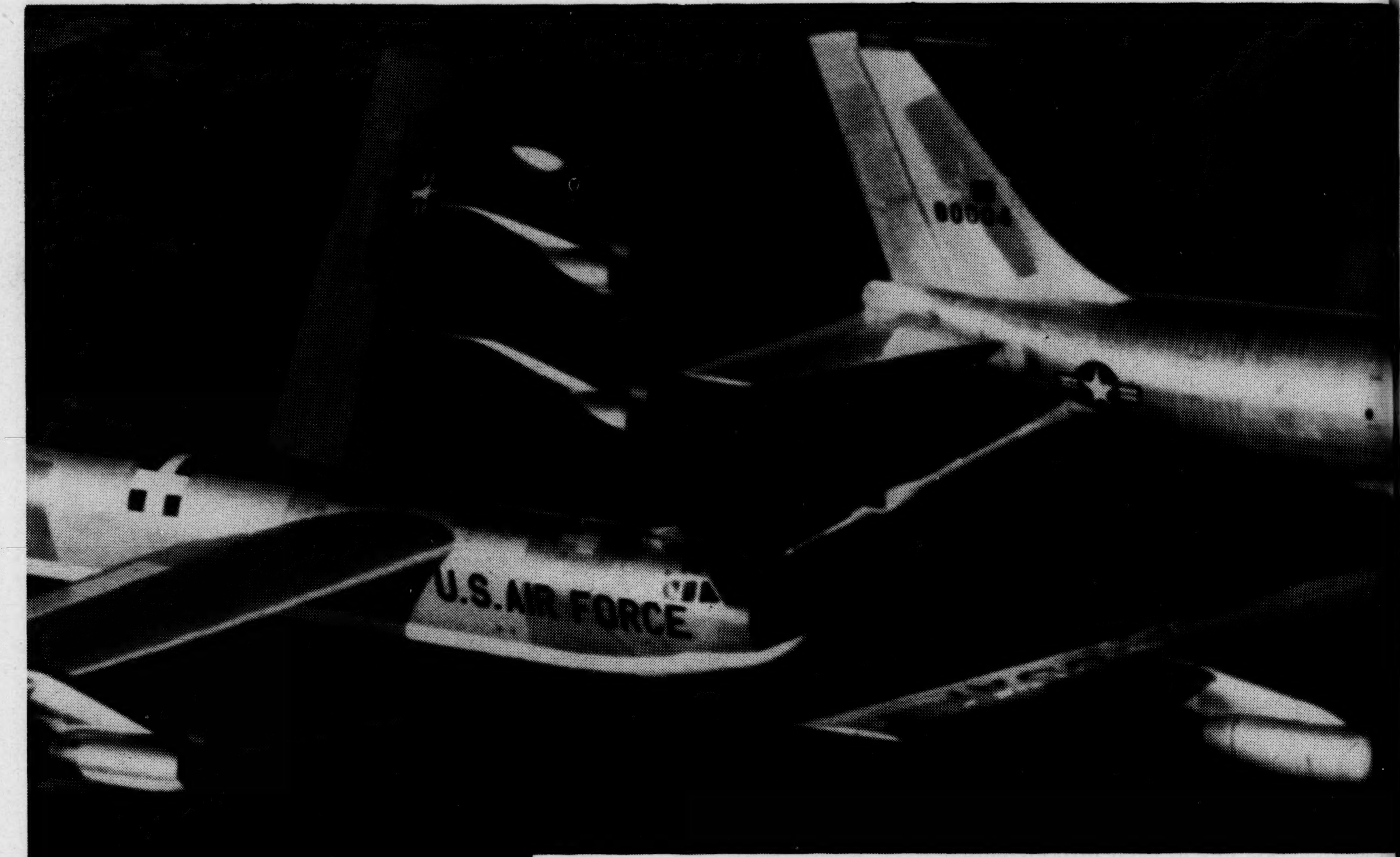
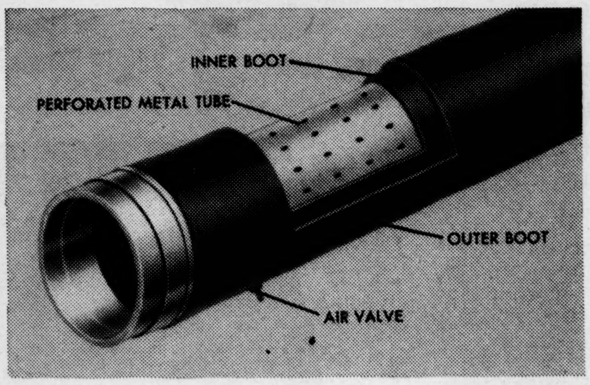
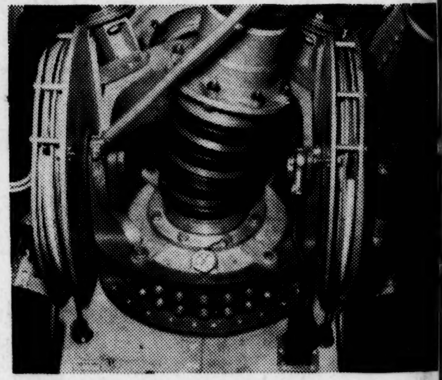
# FUEL HANDLING

## B. F. GOODRICH PRODUCES THE ANSWERS





**SURGE BOOTS**—absorb hydraulic shock.



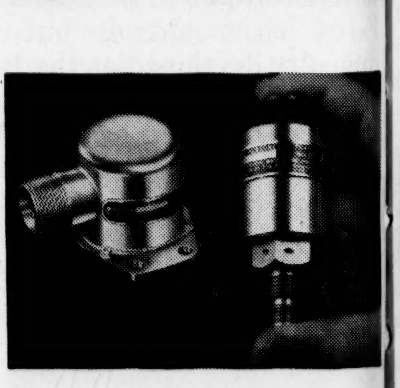
**FLEXIBLE CONNECTORS**—
for internal fuel lines.

The aerial refueling system on the U. S. Air Force KC-135 jet tanker delivers fuel at an extremely high flow-rate—yet must disconnect instantly when required.

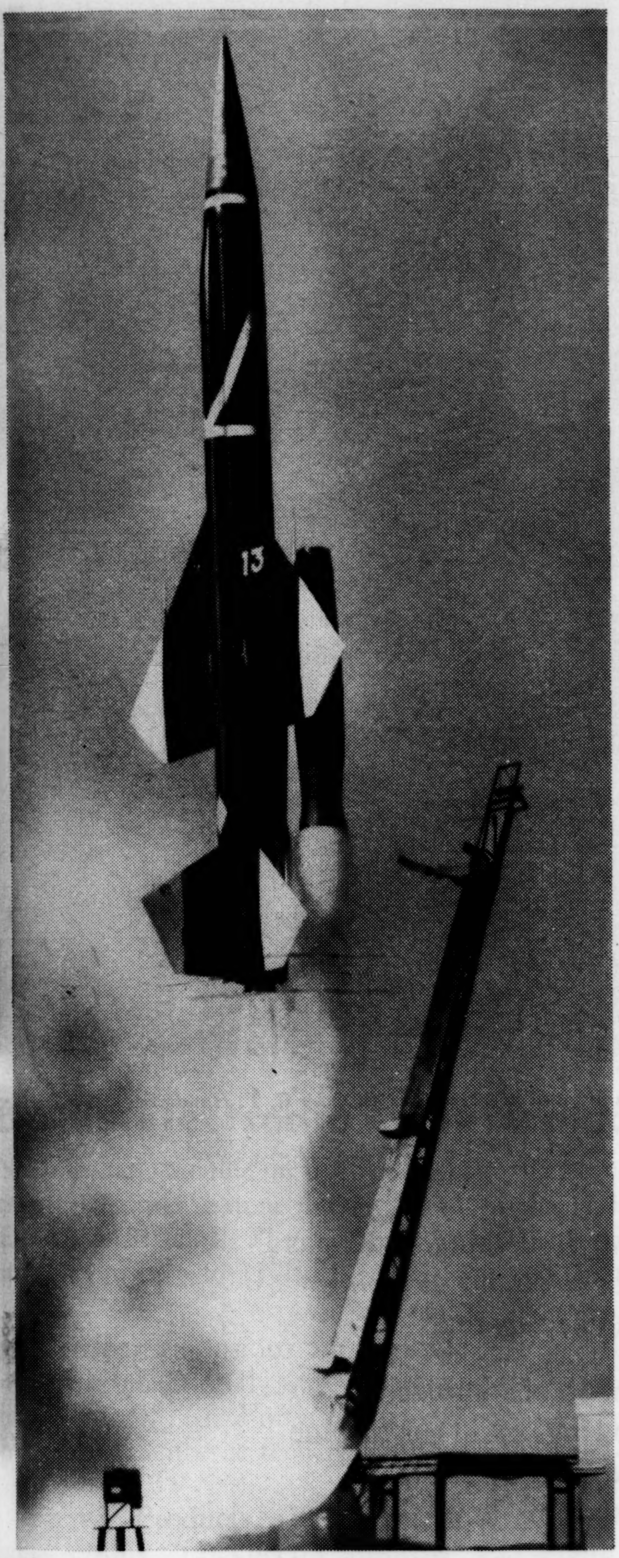
To take the tremendous shock pressure when flow is interrupted, B.F.Goodrich designed and built for Boeing a double-walled surge boot to carry fuel in the flying boom extension. A pressurized air cushion between the walls of the boot dampens shock loads, permits fast refueling with safety.

B.F.Goodrich designs and produces special products for a wide range of fueling requirements—surge boots, flexible fuel line connectors, fuel cells, hose, vapor barriers, and others for aircraft...motor cases, insulator liners, and soli propellants for rockets and missiles. For help in *your* appli cations check *B.F.Goodrich Aviation Products, a division o The B.F.Goodrich Company, Dept., AW-11B, Akron, Ohi*

**PRESSURE SWITCHES**—BFG switches actuated by precision, Omega-design bellows perform many critical functions on jet engines such as indicating adequate fuel pressure, actuating afterburner igniters and unlocking nozzle area controls.



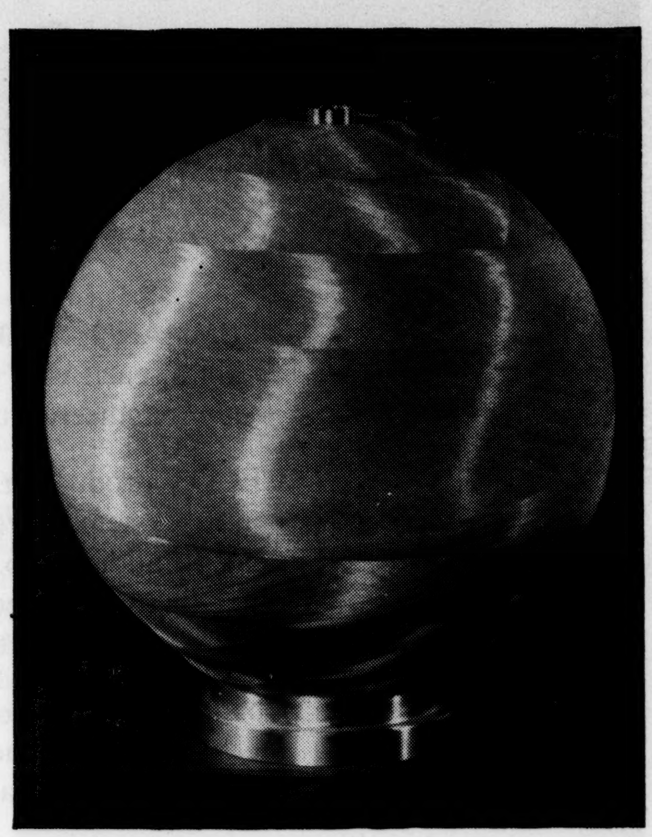
FOR UNUSUAL REQUIREMENTS



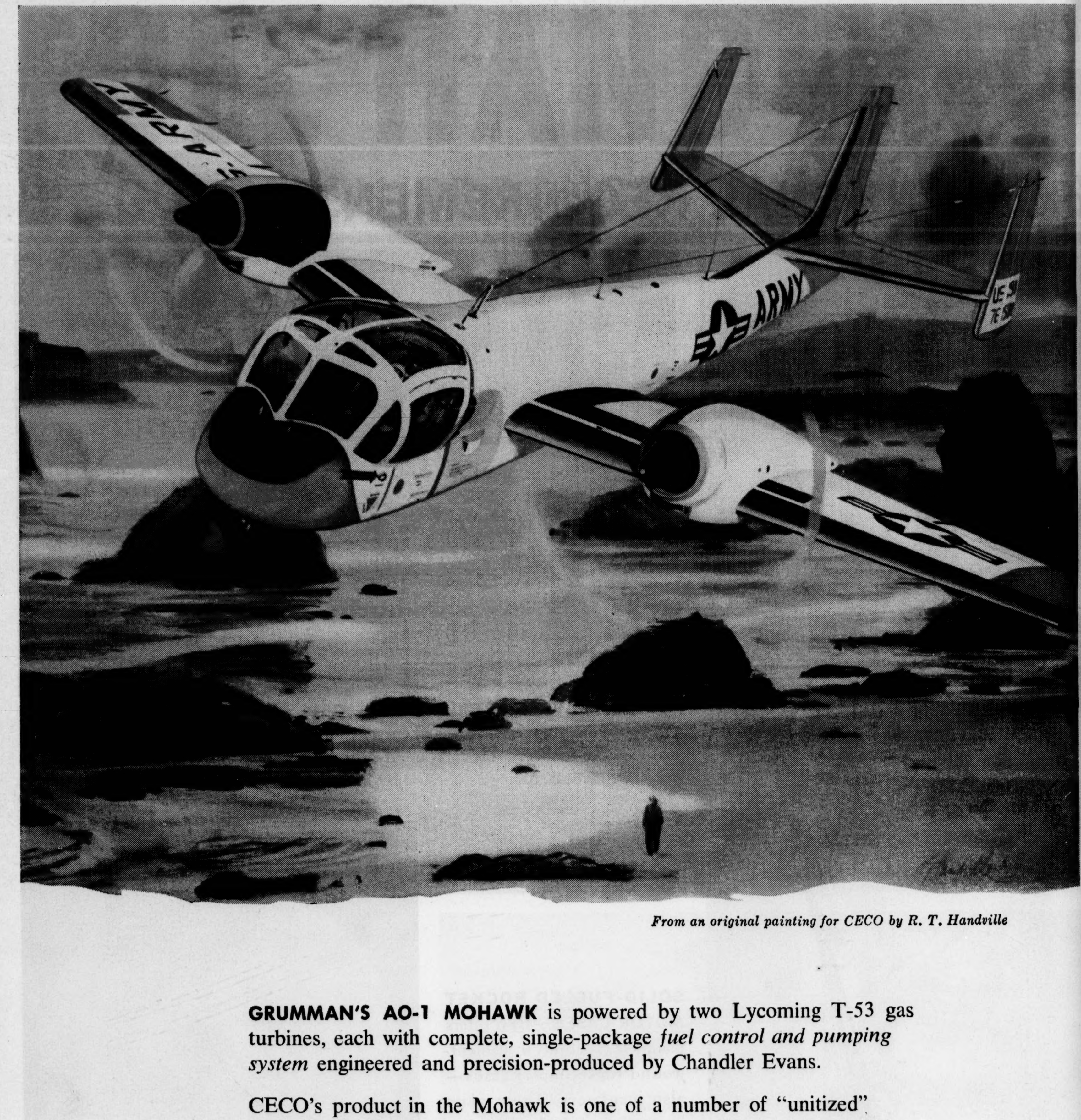
**EXPULSION DIAPHRAGM**—BFG supplies a special flexible diaphragm mounted in the fuel cavity of the Bomarc supersonic area defense missile. Diaphragm expels hydrocarbon fuels under pressure to external ram-jet engines.

**WEIGHT-SAVING FLEXIBLE FUEL CELLS**—This T-38 twin-jet trainer, made by Northrop, is one of many current aircraft using BFG fuel cells. Constructed with special fuel-resistant compounds, these cells are strong and lightweight. BFG fuel cell manufacturing is backed by complete development and test facilities.

**SOLID-FUELED ROCKET MOTOR CASES**—BFG offers complete capability in filament-wound rocket motor cases—also insulators. These glass fiber reinforced plastic structures are lightweight, strong, and are produced in many sizes and configurations.



B.F.Goodrich aviation products



*From an original painting for CECO by R. T. Handville*

**GRUMMAN'S AO-1 MOHAWK** is powered by two Lycoming T-53 gas turbines, each with complete, single-package *fuel control and pumping system* engineered and precision-produced by Chandler Evans.

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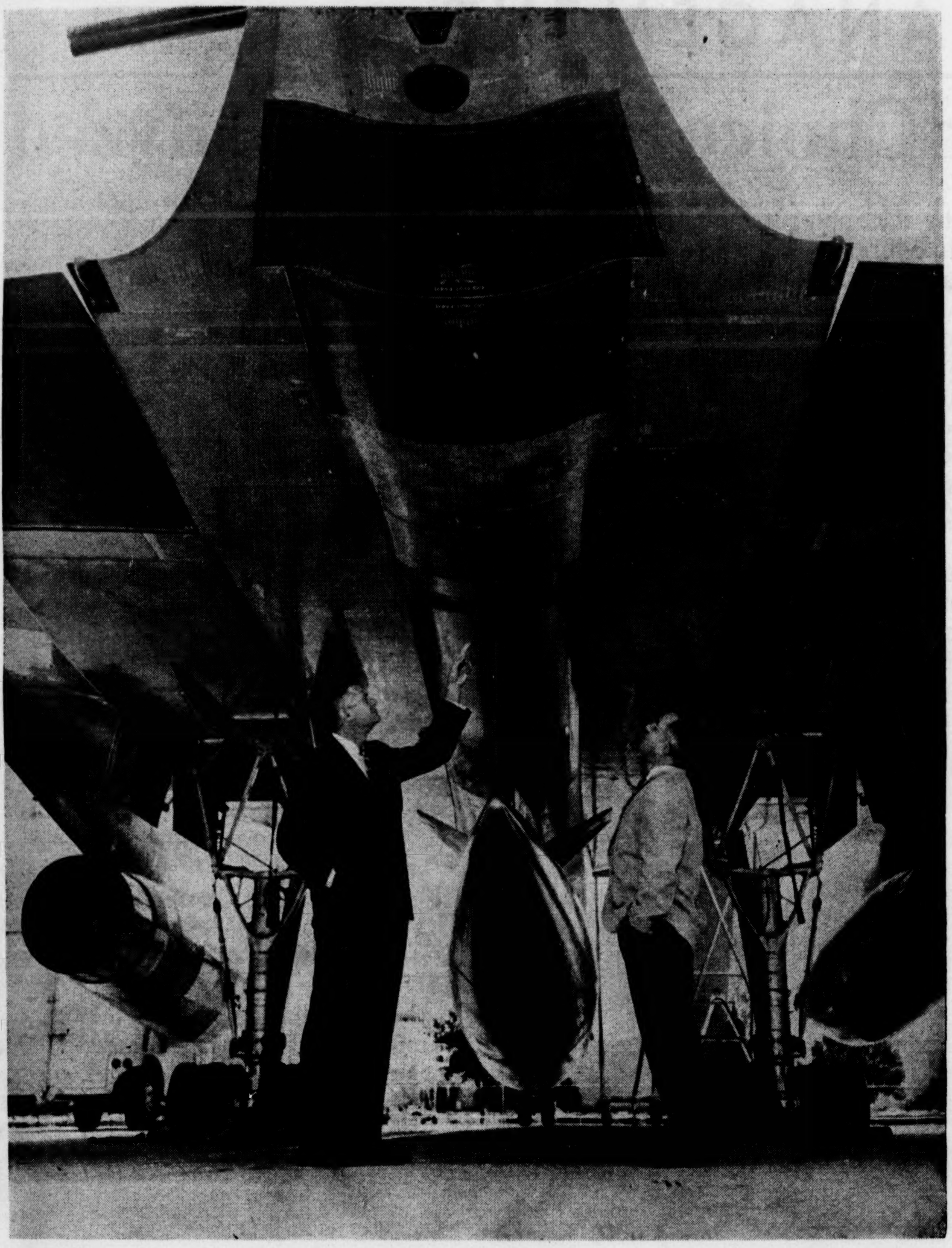


## B-58's Electronic Countermeasures Housed in Belly

**Non-magnetic radome on belly of Convair B-58 covers part of bomber's defensive electronic countermeasures system designed and produced by the Buffalo Operations of Sylvania Electronic Systems. The radome is designed to withstand 15g during flight, and temperatures from zero to 212F. B-58 weapons pod in background can carry a nuclear weapon.**

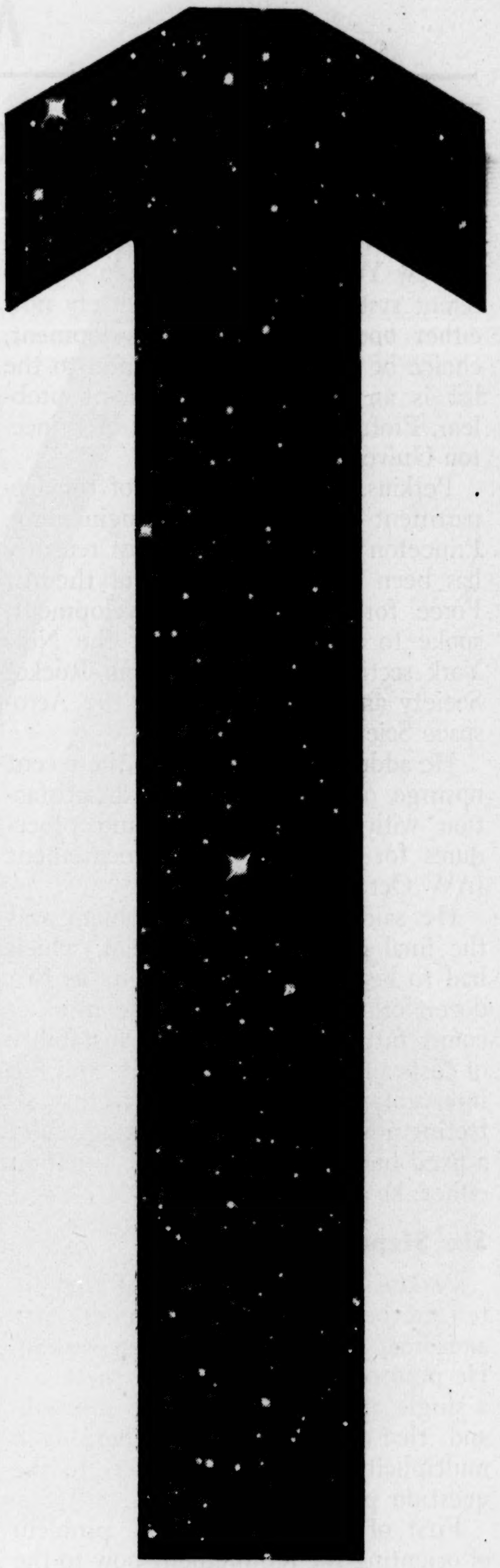
ing nuclear explosions for possible use in an international system of nuclear test control. Air Force Technical Applications Center is technical supervisor.

**Bertea Products,** Pasadena, Calif., will supply Lockheed-California Co. with control booster assemblies for the P3V-1 Orion under a contract exceeding $750,000.

**Astropower, Inc.,** recently test-fired successfully a 1,500-lb.-thrust rocket engine proposed as a vernier unit for control and stabilization of the Apollo spacecraft. The firings, first in a development test series, took place at Astropower's new 35-acre test site in the Gypsum Canyon area of the Santa Ana Mountains, Calif. Engine is powered by nitrogen tetroxide and a mixed amine fuel.

**Geoscience, Ltd.,** Solana Beach, Calif. will make theoretical and experimental investigations of new heat transfer mechanisms in high-temperature boiling liquid metals, with results to be applied to design of high power density nuclear reactors under an Atomic Energy Commission contract. First phase of the contract is for $110,000 and is scheduled for completion within one year.

**Bid invitations** have been issued for an estimated $1.75 million in additions to the Guidance and Control Division Laboratory at National Aeronautics and Space Administration's Marshall Space Flight Center, Huntsville, Ala. Major construction project is addition of 55,000 sq. ft. of office and laboratory space to the "C" wing of the NASA installation.



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# Future Weapon Choice Problems Analyzed

**By David A. Anderton**

**New York**—With more than 30 different systems for nuclear delivery now either operational or in development, choice of future weapons to add to the list is an exacting and difficult problem, Prof. Courtland Perkins of Princeton University said.

Perkins, who is chairman of the Department of Aeronautical Engineering, Princeton University and most recently has been assistant secretary of the Air Force for research and development, spoke to a joint meeting of the New York sections of the American Rocket Society and the Institute of the Aerospace Sciences.

He added his comments to the recent upsurge of publicly voiced dissatisfaction with current policies and procedures for weapon system procurement (AW Oct. 9, p. 28).

He said the toughest problem was the final choice of the system, which had to be picked from as many as two dozen others, and had to take into account future inventions, the instability of costs and program objectives, and the intervention of many other factors affecting a final decision. Working under a fixed budget didn't help the situation either, he added.

## Six Steps to Selection

Perkins delineated six steps that intervene between the requirement stage and final choice of a weapon system. He pointed out that none of them has a single approach or a single solution, and that in several cases there is a multiplicity of possible answers to the question posed.

First of the steps was the problem of orienting the requirement now to the state of the art at some future time. Perkins said there has always been contention between operational people on one hand and research and development types on the other that each was uniquely fitted to determine requirements. "Right now the top man is quite an operator," said Perkins, "And so operations are being written in the office of the DCS/O [Deputy Chief of Staff/Operations]."

Current and classic example of an airplane weapon system whose requirements called for future state-of-the-art advances was the Convair B-58 Hustler. When the requirement was first detailed, it was well ahead of contemporary engineering. Later in its development life such innovations as the area rule and conical camber caught up with the development cycle, and made the final form of the B-58 possible, Perkins said.

He also cited the USAF requirement for Aerospace Plane as one area where proponents were counting a bit too heavily on advances in technology. The concept looks fine now as an R&D project, he said, but it's too early to start writing the requirements around the idea.

Second of the major steps in system selection is the choice of the way to run the research and development program once it is funded. Here the basic choice is between full concurrency of development and the old traditional prototype-to-production chain.

## Bomber Competition

Example cited here was the first postwar bomber competition which produced the North American B-45, Convair B-46, Boeing B-47 and Martin B-48. Prototypes were built of each, they were test-flown and evaluated, and initial orders for the B-45 and B-47 were placed. Finally the big order went to the Boeing entry.

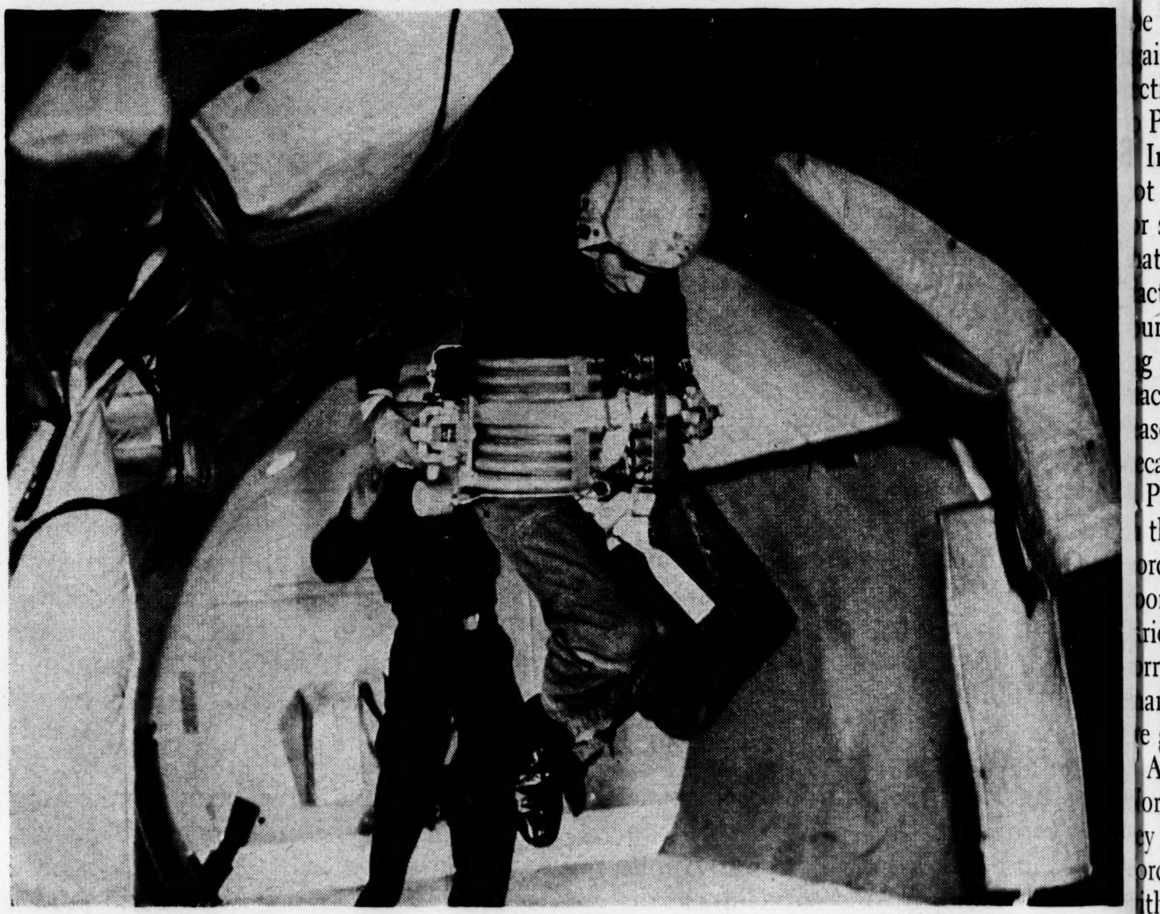
"And ever since then," said Perkins, "people have been using that program as an example of how not to get anything done."

Maybe it isn't, he added, but there doesn't seem to be any good proof one way or the other. The hooker in concurrency is if the weapon system isn't any good. The hooker in prototype development is time in the cycle. Furthermore, full concurrency is tremendously expensive, he said.

## National Survival

Perkins concluded that concurrency was worthwhile when—and only when—national survival was at stake. Atlas, Titan, Minuteman and Polaris, developed in concurrency with all their supporting and auxiliary systems, were necessarily done that way because of their importance to survival, he said. "But it doesn't necessarily follow that you should do everything this way" Perkins stated.

For an example, he pointed to the Nike Zeus anti-missile missile system. He said it was certainly necessary to national survival, but the investment in the system was going to be so enormous that maybe it would be worthwhile to wait a little more to see if it has a chance of working before



## Zero Gravity Maneuvering Belt Tested

**Air Force test officer rises to the cabin ceiling in an Air Force C-131 during zero gravity test of Bell Aerosystems Co. Zero Gravity Belt. Belt is designed to allow occupants of manned space vehicles to have a means of maneuvering when they leave the spacecraft for inspection, repair or assembly tasks. Nitrogen gas under pressure has 20 lb. thrust.**

ommitting billions of dollars to full oduction.

Instability of both costs and program bjectives is the third major hurdle in e selection of systems, Perkins said. Either we don't know how to cost, or e are unwilling to face the real costs f a full system development."

As one case of how cost estimates hange with time, he cited the Dougs Skybolt program as the ". . . most pectacular example of stretch." Doug was low bidder for the R&D program ith $120 million, he said, but within short time after the award of the ntract, Air Force Air Research and evelopment Command said that the ogram actually would cost about $240 illion. Perkins said that much scramling around in the Pentagon produced e necessary money at the expense of her development.

"Just about the time we got that ed," he said, "the Air Force came ck with 'definitized' contract and ey said it wasn't going to cost $120 illion, or even $240 million, but $330 illion!"

Perkins pointed out that nobody ould argue the value of Skybolt as a eapon system, or quarrel with its conpt or design. But he did want to emasize the kind of cost-stretching that ent on.

Fourth item on Perkins' list was the oblem of keeping a program alive. Inrservice rivalry was the first of many ctors he listed as playing an important le. "If the Air Force wants anything, e Army and Navy are automatically ainst it," he said. "It works in all dictions: the Air Force keeps referring Polaris as '. . . that 20-knot missile'."

Influence of the losing contractor is t negligible in a program's chances r survival, Perkins pointed out, saying at if you award a development conct to one of five contractors, the other ur are in your office the next day sayg that it was a lousy idea in the first ace. "They maintain the only real ason they bid in the first place was cause we wanted them to!"

Perkins said that during his tenure the Office of the Secretary of the Air orce, he was frequently appalled by the or quality of engineering selling to rious levels in the Pentagon. "The rridors are full of people with fliparts," he said, "And most of them e going to brief the wrong guy."

At one point in the life cycle of the orth American B-70, Perkins said, the y man on the project was former Air orce Secretary Dudley Sharpe, a banker ith keen appreciation of costing, but eak on the technical side. North merican wanted to present a B-70 iefing to Sharpe and Perkins arranged cautioning the team against getting o far into technical problems.

To his amazement, the North Ameri-

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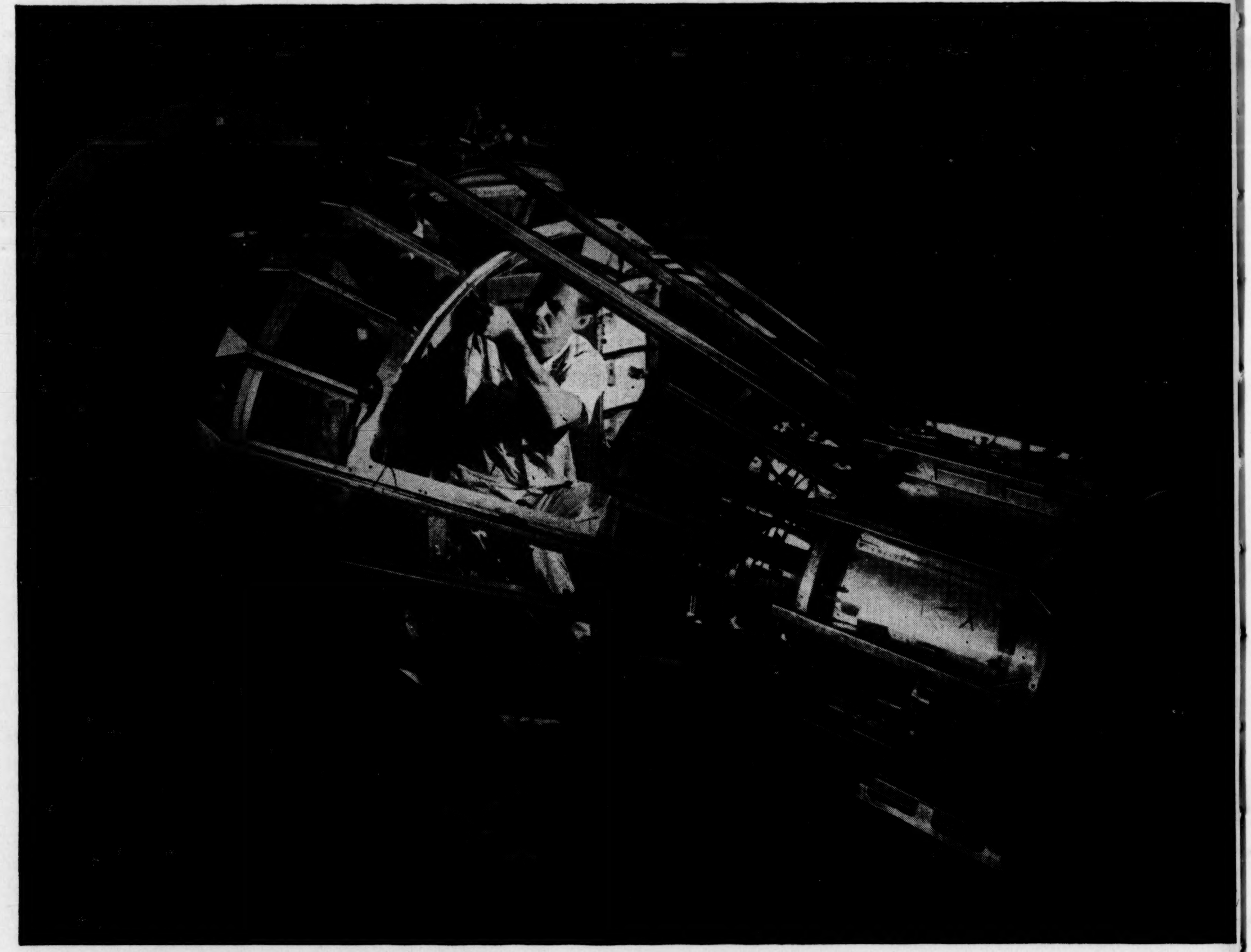

# Titanium construction clinches record of reliability with Mercury capsule!

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can engineers spent the first 30 minutes of their briefing telling Sharpe how difficult it was to make the stainless-steel honeycomb sandwiches in the B-70 structure, and about all the effort the company was expending to build, test and assemble these components. When the team later asked Perkins for an expression of their effectiveness in selling Sharpe, he told them they had certainly convinced Sharpe that it was very difficult and very expensive to make stainless-steel sandwiches.

Perkins said there was particular concern about the ways to handle the number of scientific advisers. This problem, fifth on the list, was the direct result of the large number of scientific advisers attached to government agencies. Starting at the top with the President's scientific adviser and the Scientific Advisory Board, Perkins cited some of the other groups: Director of Defense Research and Engineering, Defense Science Board, Air Force Scientific Advisory Board, plus the Navy and Army equivalents, advisers for all congressional committees concerned with defense, and even advisers to the Bureau of Budget.

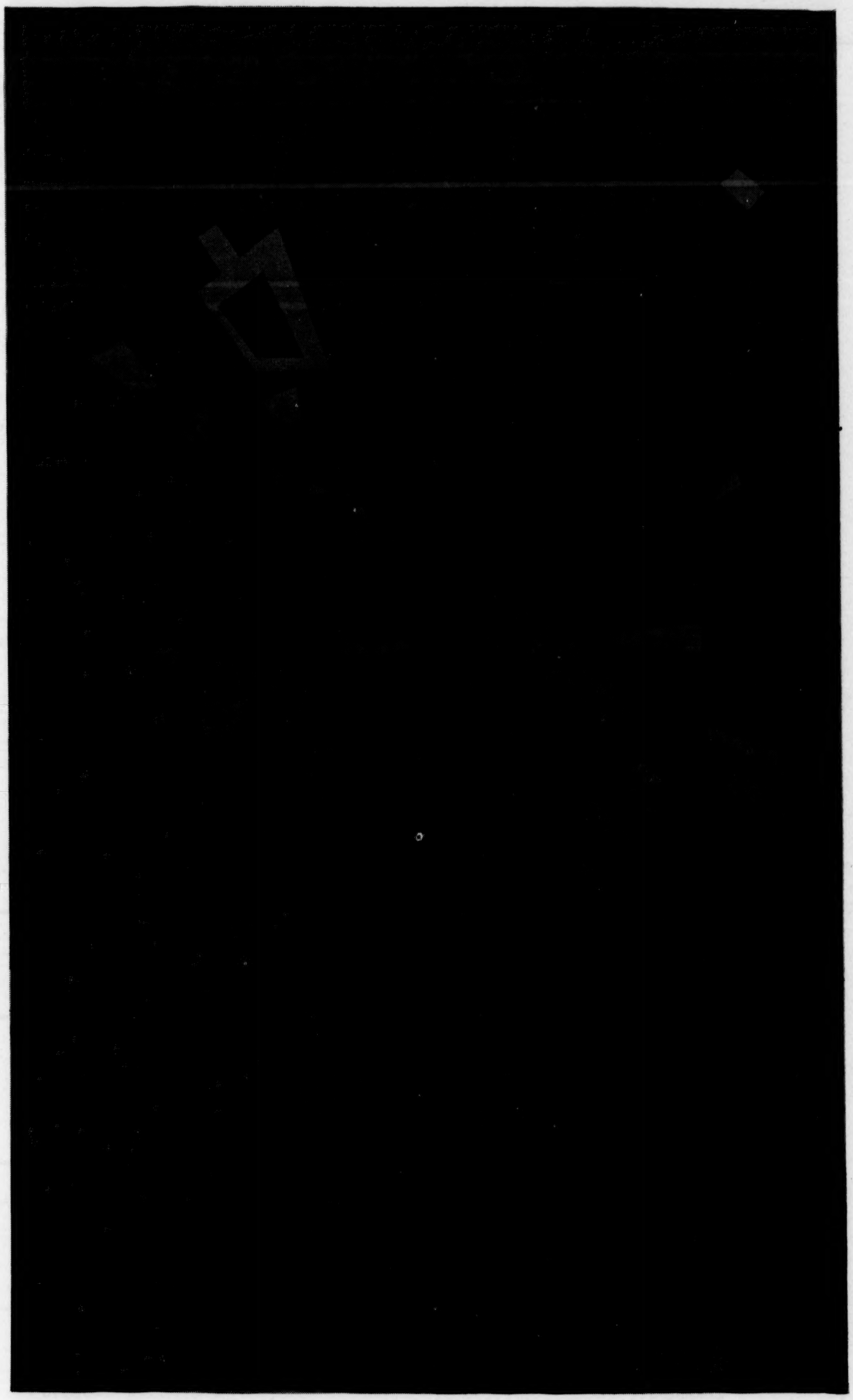
"The real problem," said Perkins, "is that these scientists are very seldom asked to give scientific advice. Instead, they want to advise on operations. I don't know why, but scientists love to talk about strategy."

Finally, with all these previous hurdles out of the way, the final and highest one remains: how to make the choice of a system.

Perkins said there are numbers of ways to justify the choice, once it has been made. Cost effectiveness, operational analyses, special competence in a field all play a part. But there are pitfalls. Cost effectiveness studies can be juggled to give the desired result by judicious choice of assumptions. Operational considerations may tend to favor one system for as long as those considerations remain unknown by the other competing teams. As soon as they find out, they also claim the same competence and can show drawings or figures to prove it.

There's no easy way to make the choice, Perkins concluded. With increasing complexity and cost of systems development, the factors affecting choice increase out of all proportion. Furthermore, the recent concept of a fixed budget has done nothing to make the situation any easier.

Perkins quoted Gen. Thomas D. White, former USAF chief, who said once that if the trend continues, he can foresee a day when there will be only enough money to fund one development program in the budget. Or, said White facetiously, maybe even only one study program.



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# U.S. Aeronautical Exports to So. Americ

Washington—U. S. exports of aircraft and parts to South America totaled $33 million in 1960, a sharp increase over 1959 and possibly the start of an upward swing in the export pattern.

Latest figures compiled by the Commerce Department's Business and Defense Services Administration show U. S. companies exported aircraft valued at $29,107,985 and parts and accessories valued at $3,493,097 in 1960 for a total of $32,601,082. This compares with totals of $19,318,231 for 1959 and $48,664,376 for 1958.

Commerce Department officials believe the light aircraft market is the most promising one in South America, noting that countries there bought 324 aircraft in 1960 which carried four or more passengers but weighed less than 3,000 lb. (empty airframe weight). This was the largest number purchased in any category.

The BDSA report on South American civil aviation will be published late this year or nearly next. It is one in a series on civilian aviation through out the world. Export figures shown below figured heavily in the Administration's forecasts on the market potential in South America.

**(In Dollars)**

| | 1958 | | 1959 | | 1960 | |
|---|---|---|---|---|---|---|
| | **Number** | **Value** | **Number** | **Value** | **Number** | **Value** |
| **Passenger Transports, Commercial, New 3,000–14,999 lb.** | 16 | 1,588,435 | 2 | 162,867 | 14 | 1,409,867 |
| Colombia | 1 | 55,000 | ...... | ............ | ...... | ............ |
| Brazil | 4 | 528,338 | 2 | 162,867 | 8 | 817,722 |
| Venezuela | 2 | 214,648 | ...... | ............ | 1 | 150,417 |
| Bolivia | 2 | 189,000 | ...... | ............ | ...... | ............ |
| Chile | 3 | 231,600 | ...... | ............ | 1 | 78,177 |
| Argentina | 4 | 369,849 | ...... | ............ | 1 | 99,851 |
| Peru | ...... | ............ | ...... | ............ | 2 | 156,000 |
| Uruguay | ...... | ............ | ...... | ............ | 1 | 107,700 |
| **15,000–29,999 lb.** | 7 | 4,407,485 | ...... | ............ | ...... | ............ |
| Venezuela | 5 | 2,886,585 | ...... | ............ | ...... | ............ |
| Brazil | 2 | 1,520,900 | ...... | ............ | ...... | ............ |
| **30,000 lb. and over** | 16 | 23,138,386 | 4 | 4,503,700 | 2 | 11,328,618 |
| Peru | 1 | 1,500,000 | ...... | ............ | ...... | ............ |
| Brazil | 9 | 11,115,304 | 4 | 4,503,700 | 2 | 11,328,618 |
| Chile | 4 | 5,998,288 | ...... | ............ | ...... | ............ |
| Argentina | 2 | 4,524,794 | ...... | ............ | ...... | ............ |
| **Rotary Wing Aircraft, Commercial, New** | 2 | 223,465 | ...... | ............ | 2 | 278,580 |
| Ecuador | 1 | 47,750 | ...... | ............ | ...... | ............ |
| Brazil | 1 | 175,715 | ...... | ............ | ...... | ............ |
| Chile | ...... | ............ | ...... | ............ | 1 | 171,355 |
| Argentina | ...... | ............ | ...... | ............ | 1 | 107,225 |
| **Commercial and Civilian Aircraft, Used and Rebuilt, including Converted** | 52 | 12,250,480 | 50 | 4,558,361 | 47 | 7,624,759 |
| Colombia | 3 | 140,000 | 10 | 1,639,937 | 8 | 724,000 |
| Venezuela | 6 | 4,260,000 | 7 | 520,949 | 7 | 1,005,000 |
| Peru | 4 | 478,920 | 1 | 38,920 | 9 | 1,380,500 |
| Chile | 5 | 869,760 | 7 | 162,500 | 1 | 480,759 |
| Brazil | 15 | 4,947,000 | 9 | 525,000 | 6 | 516,000 |
| Paraguay | 1 | 5,500 | 3 | 123,000 | ...... | ............ |
| Argentina | 10 | 944,300 | 13 | 1,548,055 | 10 | 2,200,000 |
| Ecuador | 4 | 180,000 | ...... | ............ | 2 | 650,000 |
| Bolivia | 4 | 425,000 | ...... | ............ | 4 | 688,500 |
| **Under 3,000 lb.: Utility, Commercial and Civilian, New: 3 Places and Under** | 39 | 328,772 | 111 | 1,512,547 | 83 | 783,013 |
| Colombia | 14 | 128,500 | 44 | 428,236 | 21 | 206,610 |
| Venezuela | 4 | 30,500 | 5 | 38,478 | 5 | 41,096 |
| Ecuador | 6 | 54,000 | 4 | 36,265 | 14 | 134,540 |
| Peru | 1 | 5,000 | 5 | 43,425 | 3 | 17,559 |
| Chile | 1 | 5,792 | 5 | 37,302 | 7 | 49,517 |
| Brazil | 1 | 4,875 | 3 | 20,930 | ...... | ............ |
| Paraguay | 2 | 15,000 | 4 | 22,640 | ...... | ............ |
| Uruguay | 2 | 18,000 | 2 | 18,000 | 3 | 47,400 |
| Argentina | 8 | 67,105 | 39 | 867,271 | 28 | 263,541 |
| Bolivia | ...... | ............ | ...... | ............ | 2 | 22,750 |

# Show Sharp Rise in 1960

| | 1958 | | 1959 | | 1960 | |
|---|---|---|---|---|---|---|
| | Number | Value | Number | Value | Number | Value |
| 4 Places and over | 145 | 2,455,891 | 150 | 2,857,231 | 324 | 5,989,333 |
| Colombia | 4 | 105,380 | 12 | 153,094 | 5 | 101,832 |
| Venezuela | 15 | 542,630 | 19 | 548,526 | 22 | 548,328 |
| Ecuador | 1 | 30,000 | 1 | 13,000 | 5 | 62,329 |
| Peru | 1 | 10,000 | 2 | 82,000 | 8 | 139,147 |
| Bolivia | 5 | 76,772 | 3 | 68,394 | 3 | 42,470 |
| Chile | 6 | 92,264 | 24 | 407,406 | 23 | 546,912 |
| Brazil | 62 | 794,316 | 28 | 505,483 | 93 | 1,789,641 |
| Paraguay | 17 | 246,439 | 7 | 101,298 | 5 | 126,006 |
| Uruguay | 3 | 29,860 | 7 | 127,135 | 15 | 316,632 |
| Argentina | 31 | 528,230 | 47 | 850,895 | 145 | 2,316,036 |
| Rotary Wing, Commercial, New | 7 | $233,880 | 9 | $505,505 | 22 | $1,218,689 |
| Argentina | ...... | ............ | ...... | ............ | 1 | 80,730 |
| Chile | ...... | ............ | ...... | ............ | 4 | 223,800 |
| Bolivia | ...... | ............ | ...... | ............ | 1 | 2,660 |
| Colombia | ...... | ............ | 1 | 27,000 | ...... | ............ |
| Venezuela | 2 | 109,880 | 6 | 346,259 | ...... | ............ |
| Brazil | ...... | ............ | 2 | 132,246 | 15 | 843,472 |
| Ecuador | 5 | 124,000 | ...... | ............ | 1 | 68,027 |
| Other New Commercial and Civilian Aircraft | 1 | $90,000 | 2 | $2,807,500 | ...... | ............ |
| Brazil | ...... | ............ | 2 | 2,807,500 | ...... | ............ |
| Bolivia | 1 | 90,000 | ...... | ............ | ...... | ............ |
| Commercial and Civilian Aircraft, Used and Rebuilt, including Converted | 48 | 419,010 | 24 | 227,200 | 41 | $475,126 |
| Paraguay | 1 | 14,000 | ...... | ............ | ...... | ............ |
| Colombia | 6 | 121,500 | 3 | 28,000 | 6 | 156,560 |
| Venezuela | 4 | 15,360 | 4 | 36,450 | 2 | 17,500 |
| Ecuador | 3 | 47,000 | 3 | 25,500 | 9 | 107,926 |
| Bolivia | ...... | ............ | 4 | 58,762 | 2 | 28,750 |
| Chile | 6 | 27,150 | 3 | 3,200 | ...... | ............ |
| Brazil | 5 | 54,600 | 2 | 10,500 | 4 | 19,500 |
| Uruguay | 2 | 20,000 | 1 | 25,000 | 3 | 24,000 |
| Argentina | 20 | 118,400 | 4 | 39,788 | 3 | 27,250 |
| Peru | 1 | 1,000 | ...... | ............ | 12 | 93,640 |
| **Total Aircraft** | **333** | **$45,135,804** | **352** | **$17,134,911** | **535** | **$29,107,985** |
| Parts and Accessories Aircraft Engines, Reciprocating, New Air-Cooled under 400 HP | 228 | $672,512 | 213 | $533,211 | 244 | $669,840 |
| Colombia | 11 | 23,170 | 27 | 66,172 | 24 | 62,308 |
| Venezuela | 14 | 47,540 | 15 | 67,590 | 21 | 62,026 |
| Ecuador | 11 | 28,936 | 13 | 35,298 | 36 | 82,512 |
| Peru | 2 | 6,820 | 5 | 11,500 | 6 | 16,323 |
| Bolivia | 14 | 70,261 | 2 | 5,628 | 5 | 16,576 |
| Chile | 12 | 21,782 | 16 | 86,786 | 6 | 15,796 |
| Brazil | 91 | 285,953 | 70 | 144,565 | 79 | 201,946 |
| Paraguay | 7 | 22,796 | 5 | 16,575 | 2 | 6,861 |
| Uruguay | 2 | 8,678 | 1 | 1,487 | 3 | 5,958 |
| Argentina | 64 | 156,576. | 59 | 97,610 | 62 | 199,534 |
| Aircraft Engines, Reciprocating, Used and Rebuilt | 497 | $2,856,060 | 363 | $1,650,109 | 539 | $2,823,257 |
| Colombia | 74 | 230,516 | 92 | 445,347 | 103 | 505,409 |
| Venezuela | 125 | 1,063,311 | 99 | 423,976 | 96 | 372,094 |
| Ecuador | 24 | 70,938 | 20 | 57,313 | 18 | 46,791 |
| Peru | 42 | 170,095 | 29 | 112,250 | 34 | 137,125 |
| Bolivia | 15 | 69,500 | 46 | 184,674 | 58 | 212,158 |
| Chile | 12 | 132,162 | 9 | 47,300 | 13 | 55,113 |
| Brazil | 131 | 744,348 | 39 | 260,170 | 140 | 1,044,002 |
| Paraguay | 5 | 14,100 | 1 | 2,000 | 6 | 32,580 |
| Uruguay | 16 | 65,850 | 8 | 30,500 | 6 | 25,083 |
| Argentina | 53 | 295,240 | 20 | 86,579 | 65 | 392,902 |
| **Total Parts, Accessories** | **725** | **$3,528,572** | **576** | **$2,183,320** | **783** | **$3,493,097** |
| **Grand Total (aircraft, parts, accessories)** | **1,058** | **$48,664,376** | **928** | **$19,318,231** | **1,318** | **$32,601,082** |

**Note: All weights are empty air frame weights.**

[1] **Totals are not all inclusive because data by country are not available on many items of components, parts, and accessories.**

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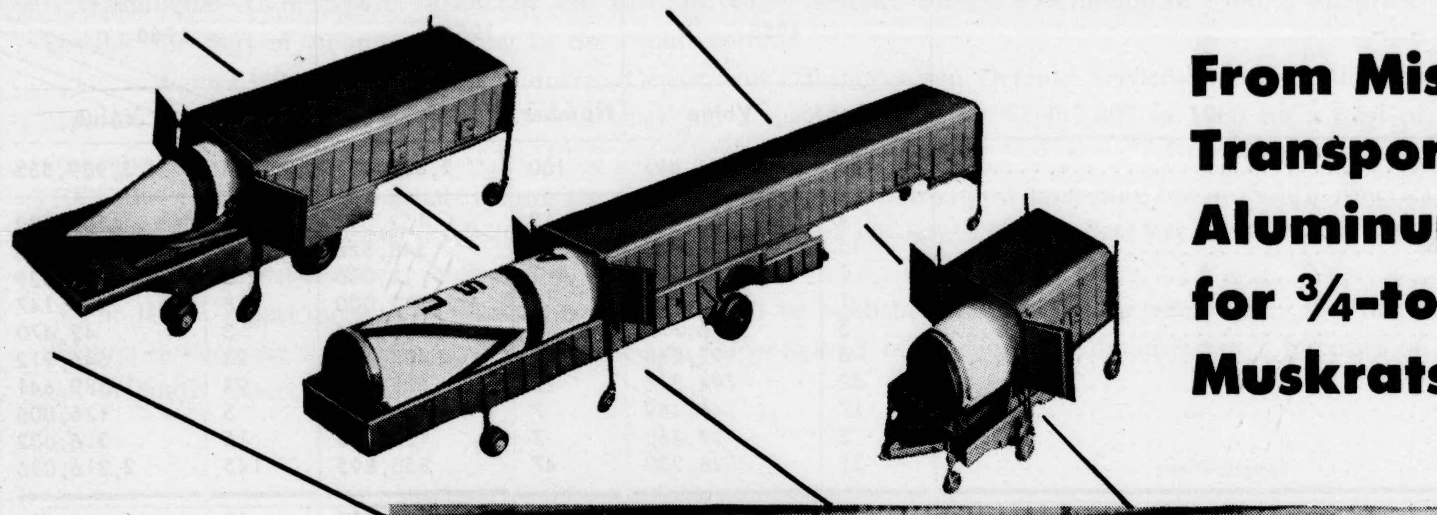
# DIVERSIFICATION . . .

## From Missile Transporters to Aluminum Bodies for ¾-ton Muskrats!



U.S. ARMY - 3B 4796

The military's newest ¾-ton cargo and personnel carrier, the "Muskrat", designed and developed by American Motors Corporation. Equally at home on land or water, the "Muskrat" can also be delivered by helicopter or parachute.

Fruehauf has the ability *and* facilities to adjust quickly to your G.S.E. problems. As a prime or subcontractor, Fruehauf has long been the acknowledged leader in the design, research, development and production of Ground Support Equipment. Fruehauf's diversified experience ranges from the production of jet target launchers and giant Redstone transporters to special military trailers and containers. Also Fruehauf R&D cooperates in the building of special equipment and prototypes such as the body produced for the "Muskrat", the unique new ¾-ton military cargo and personnel carrier designed and developed by American Motors Corporation. Here are a few of the many benefits which Fruehauf, as a prime or subcontractor, offers you:

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★ 11 modern manufacturing plants spread across America
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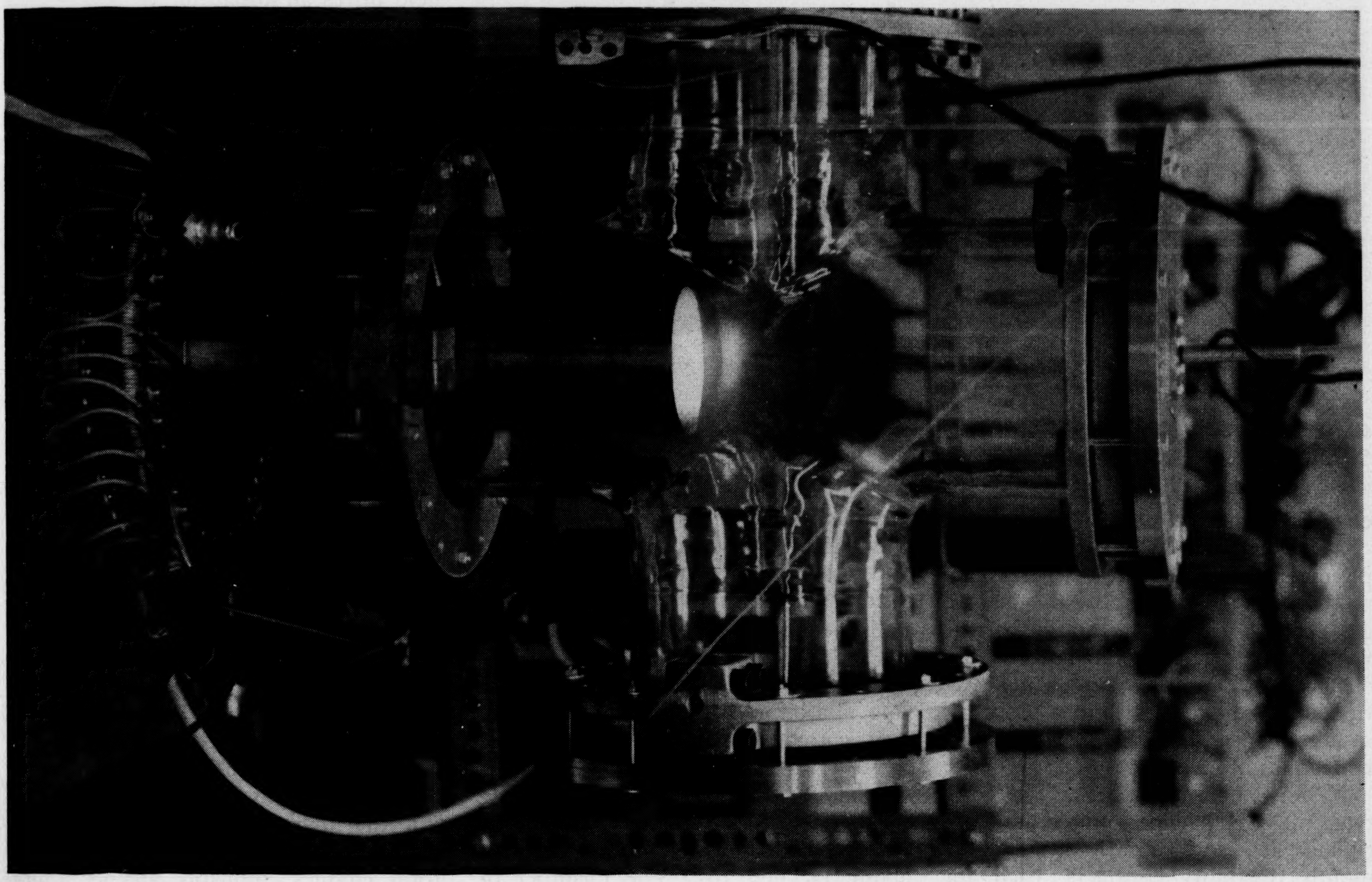
Plants in the East and West

**MILITARY EQUIPMENT DIVISION — DETROIT 32, MICH.**

**MISSILE PRODUCTS DIVISION — LOS ANGELES 58, CALIF.**



**COAXIAL PLASMA GUN** being studied by General Dynamics/Astronautics for NASA, is basically two cylinders, one within the other. Gas is introduced in the annular space between cylinders and an arc discharge creates a magnetic pressure wave, pushing gas ahead of it.

# Major Space Role Seen for Plasma Engine

By George Alexander

Magnetohydrodynamic engines will be the major contender among electric powerplants to meet in-space propulsive requirements of space vehicles through the 1970s, according to Ira R. Schwartz, acting chief of National Aeronautics and Space Administration's Space Propulsion Office.

Schwartz told Aviation Week that "a consensus of opinion seems to exist among the spacecraft people that the specific impulse range between 1,000 and 3,500 sec." will be required of most unmanned space vehicle powerplants over the next 10 years.

Magnetohydrodynamic (MHD) engines, which basically develop thrust in the acceleration of a plasma by means of magnetic fields, are the only type that can fulfill this requirement adequately, Schwartz said, since this propulsive bandwidth falls between the upper limit of arc jet engines and the lower limit of ion motors.

The NASA space propulsion chief said that while arc jet engines should be ready for flight testing in 1962, "rapid progress is being made with MHD units and we should be ready to fly one on a satellite mission around 1965 or 1967." Experimental flight tests of both MHD and ion engines, using conventional batteries, could be made around 1964, he said.

Schwartz said that in their applications, MHD, ion and arc jet engines are complementary and not competitive systems. "It is not only conceivable but more than likely," Schwartz said, "that a spacecraft will someday carry two, or even three, types of electric engines for different purposes." The arc jet would be used mostly for station keeping and attitude control, he said, while the ion and MHD units would be used as prime propulsion systems. Mission requirements probably would dictate a choice between them, Schwartz explained.

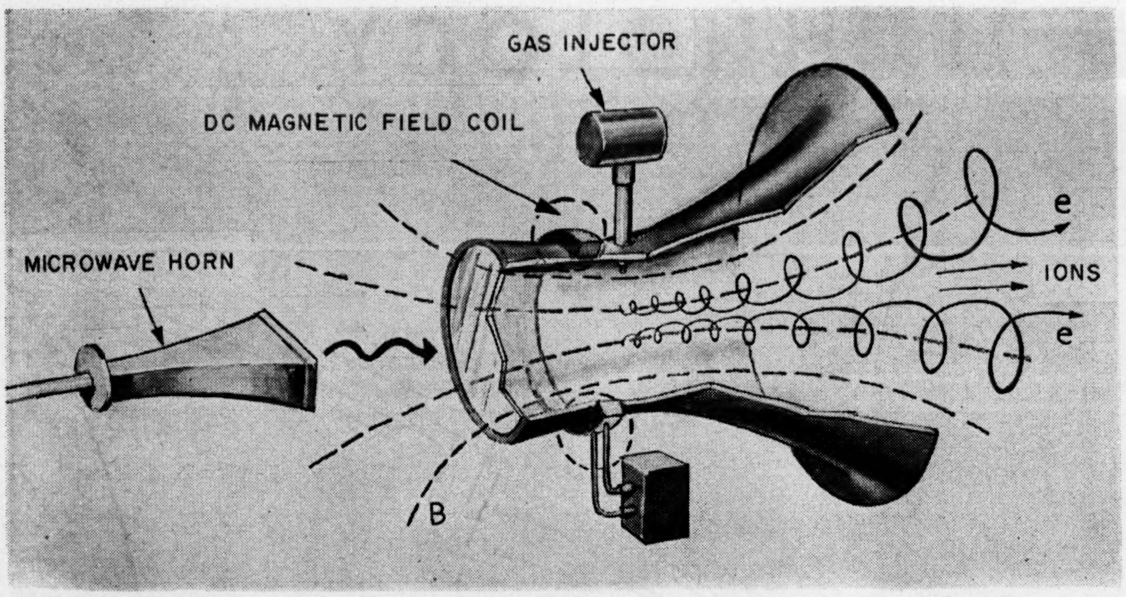
Thrust range of operational ion engines is expected to be between 0.01 to 0.5 lb., with specific impulses of 3,500 to 10,000 sec. MHD engines should deliver between 0.01 to 1 lb. thrust, with specific impulses running from 700 to 10,000 sec. Arc jets will produce from 0.01 to 1 lb. thrust, but with a specific impulse of only 700 to 1,500 sec., Schwartz said.

The potential of both ion and MHD engines is greater than 10,000 sec., Schwartz stated, if the present limitations of high-temperature materials and lighter weight, more compact nuclear power sources are resolved.

Taking these parameters into consideration, Schwartz said that it would be unlikely that an ion engine would be chosen to power a manned spacecraft on a 200-day deep space exploration when an MHD unit could cut the flight time "by approximately one half." But where lower thrust levels and longer flight times were acceptable, he added, such as in an unmanned probe, an ion engine would be satisfactory.

Other advantages of MHD engines over ion units, Schwartz said, include the following:

- **Greater payload capability,** because the specific thrust of the MHD system is greater than that of the ion engine.
- **Lesser complexity** of MHD design than ion configurations, although not presently an accomplished fact, could be achieved within the development of the former system. Reliability is also expected to be higher for MHD engines.
- **Absence of exhaust neutralization** and electrode erosion problems in MHD



**GENERAL ELECTRIC** uses ultra high frequency radio energy to excite and ionize a gas. Steady magnetic field accelerates the plasma.

engines compared with ion systems.

MHD engines use a neutrally charged plasma to develop thrust, whereas ion powerplants must neutralize the charged gas exhaust leaving the nozzle to prevent flow to the comparatively uncharged space vehicle. And while electrode erosion presents serious problems in ion engines, MHD could use eroded material as propellant.

NASA is now investigating two basic types of MHD engines, pulsed and continuous flow, and recently awarded 12-month feasibility contracts, each for approximately $100,000, to General Electric's Missile and Space Vehicle Dept., Philadelphia, Pa.; Clauser Technology Corp., Torrance, Calif., and General Dynamics/Astronautics, San Diego, Calif., for studies of the pulsed type engine and to the team of Marquardt Corp., Van Nuys, Calif., and Magnetohydrodynamics, Inc., Newport Beach, Calif., for study of the continuous flow concept.

Pulsed MHD engines operate in this manner: a very high voltage discharges an arc at intervals across two electrodes within a chamber, causing partial ionization of the gas within the chamber. A magnetic field also is induced around the current flowing between the two electrodes and, like a piston, exerts a force on the plasma to push it toward the nozzle. With discharge occurring of about 150 cps. or higher, the plasma is bumped along and then out of the chamber. In continuous flow MHD engines, the arc between electrodes is constant but not nearly so great as in pulsed units. It also causes partial ionization but exerts only enough magnetic pressure to move the plasma further down the chamber, where externally mounted magnets accelerate the plasma's flow.

The GE/MSVD approach is to excite and partially ionize a gas leaking slowly at a controlled rate into the propulsion chamber by ultra high frequency (UHF) radio waves. The chamber, wrapped in a tightly wound coil, is immersed in a steady magnetic field and the plasma, under its influence, rotates —similar to electrons in a cyclotron.

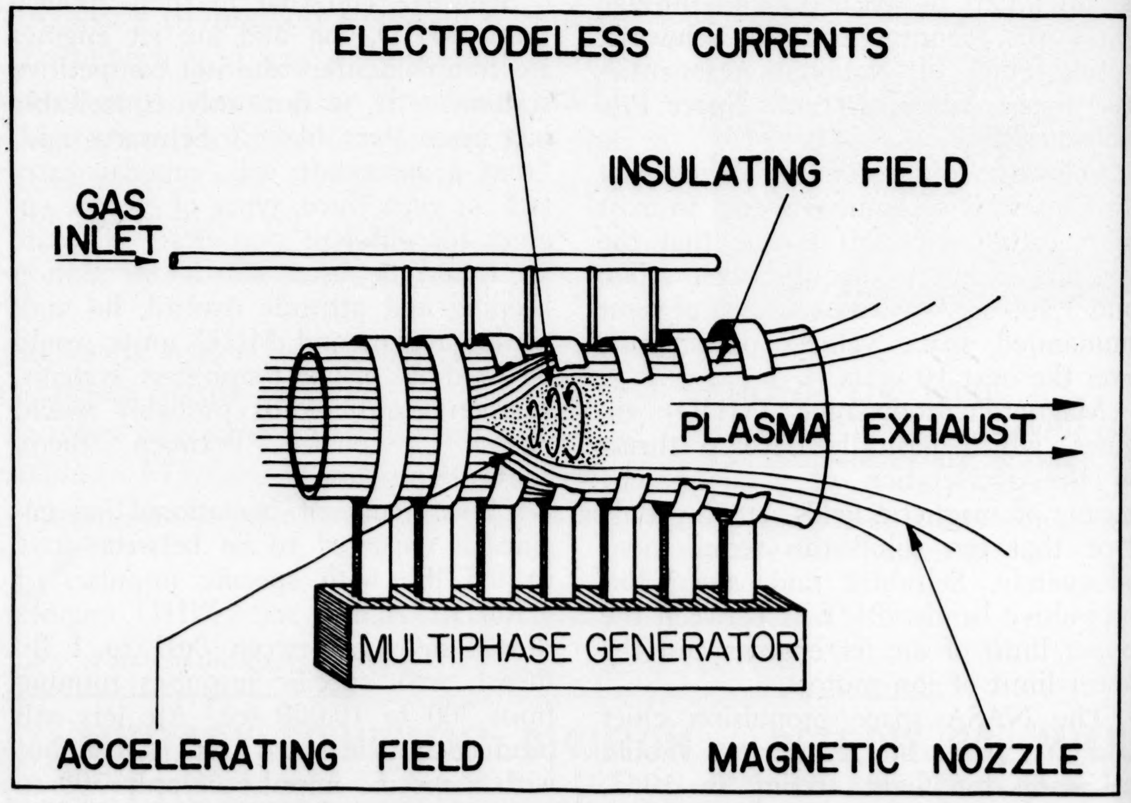
This cyclotronic energy is coupled with the UHF power and the plasma is driven out of the chamber in a spiralling motion. A magnetic nozzle, however, corrects the spiral flow to a linear flow.

Clauser Technology uses a traveling magnetic field technique and, in tests, has accelerated plasmas to velocities of about 125,000 fps. The chamber of this engine is wrapped with a series of coils, each of which is connected to separate capacitors. The capacitors are discharged sequentially, starting from the rear of the chamber and working toward the nozzle, so that the magnetic field is continually shifting. The plasma within the chamber, with a current induced in it by the magnetic field, is drawn toward the nozzle by the forward-moving magnetic fields. Schwartz likens this concept to a common induction motor, in which a moving magnetic field drives an armature.

General Dynamics/Astronautics, studying a coaxial plasma gun, injects a minute quantity of gas into an annular gap between two cylindrical electrodes just before a current discharge across the gap. Operating on a pulsed basis, the doughnut-shaped discharge pushes the gas within the annulus ahead of it. Driving force is obtained from the magnetic field created by the current flows.

Marquardt and Magnetohydrodynamics, Inc., create a plasma by a constant arc discharge in the upper half of a two-section engine. Given an initial impetus by thermal expansion, the plasma passes through a convergent-divergent throat into the lower half of the engine, which is configured like a rectangular box. On opposite sides of this box are a permanent magnet and a series of additional electrodes to provide multiple discharge points. At constant intervals, these additional electrodes are discharged, causing further ionization of the plasma, and induce a current in the gas flow, which is then accelerated by the magnetic field.

Central to all electric propulsion engines is a nuclear power source to provide the high power levels required by the nature of the engines. First generation engines, probably arc jet units used to maintain communication satellites in synchronous orbits, are being developed around the 3-kw. Snap 2 power system. Schwartz said that first generation MHD and ion engines probably will be flown with the 30 to 60 kw. Snap 8 units, but that "the large payoff for spacecraft utilizing electric propulsion systems will be realized only when power sources of the megawatt level become available."



**CLAUSER TECHNOLOGY CORP.** accelerates a plasma by coils surrounding chamber which are sequentially discharged, rear to front, to create a forward-moving magnetic field.

# Space Vehicle Log

(As of Oct. 1, 1961)

| Satellites in Orbit[1] | Name | Launch | Period (Min.) | Apogee (Stat. Mi.) | Perigee (Stat. Mi.) | Transmitting[2] Freq. (Mc.) | Weight in Orbit[3] (Lb.) |
|---|---|---|---|---|---|---|---|
| 1958 Alpha 1 | Explorer I | 1 Feb. 58 | 106.1 | 1,094 | 217 | | 30.8 |
| 1958 Beta 2 | Vanguard I | 17 Mar. 58 | 133.8 | 2,449 | 404 | 108.022 | 56.3 |
| 1959 Alpha 1 | Vanguard II | 17 Feb. 59 | 125.2 | 2,033 | 354 | | 21.5 |
| 1959 Delta 1 | Explorer VI | 7 Aug. 59 | Position Uncertain | | | | 142 |
| 1959 Eta 1 | Vanguard III | 18 Sept. 59 | 129.7 | 2,319 | 310 | | 100 |
| 1959 Mu-USSR | Lunik I | 2 Jan. 59 | 450 Days | 1.3177AU | 0.9766AU | | 3,245 |
| 1959 Nu | Pioneer IV | 3 Mar. 59 | 398 Days | 1.1421AU | 0.9871AU | | 13.4 |
| 1959 Iota 1 | Explorer VII | 13 Oct. 59 | 101.1 | 670 | 344 | 19.9904 | 91.5 |
| 1960 Alpha | Pioneer V | 11 Mar. 60 | 311.6 Days | 0.9951AU | 0.8061AU | | 94.8 |
| 1960 Beta 2 | Tiros I | 1 Apr. 60 | 99.1 | 467 | 429 | 107.997 | 270 |
| 1960 Gamma 2 | Transit 1B | 13 Apr. 60 | 94.8 | 409 | 229 | | 265 |
| 1960 Epsilon 1-USSR | Sputnik IV | 15 May 60 | 92.1 | 291 | 175 | | 10,008 |
| 1960 Zeta 1 | Midas II | 24 May 60 | 94.5 | 317 | 294 | | 5,000 |
| 1960 Eta 1 | Transit 2A | 22 Jun. 60 | 101.6 | 649 | 389 | 162; 216; 108.06 | 223 |
| 1960 Eta 2 | Greb | 22 Jun. 60 | 101.6 | 657 | 381 | | 42 |
| 1960 Iota 1 | Echo I | 12 Aug. 60 | 116.6 | 1,221 | 682 | | 240 |
| 1960 Nu 1 | Courier 1B | 4 Oct. 60 | 106.8 | 755 | 599 | 107.9709 | 500 |
| 1960 Xi 1 | Explorer VIII | 3 Nov. 60 | 112.5 | 1,408 | 262 | | 90.14 |
| 1960 Pi 1 | Tiros II | 23 Nov. 60 | 98.2 | 461 | 378 | 108; 108.3 | 280 |
| 1961 Alpha 1 | Samos II | 31 Jan. 61 | 94.9 | 340 | 295 | | 4,100 |
| 1961 Gamma 1-USSR | Venus Probe | 12 Feb. 61 | 300 Days | 1.019AU | 0.7183AU | | 1,419 |
| 1961 Delta 1 | Explorer IX | 16 Feb. 61 | 118.1 | 1,555 | 438 | | 80 |
| 1961 Epsilon 1 | Discoverer XX | 17 Feb. 61 | 93.8 | 393 | 176 | | 2,450 |
| 1961 Zeta 1 | Discoverer XXI | 18 Feb. 61 | 94.8 | 475 | 154 | | N.A. |
| 1961 Kappa 1 | Explorer X | 25 Mar. 61 | Position Uncertain | | | | 79 |
| 1961 Lambda 1 | Discoverer XXIII | 8 Apr. 61 | 92.8 | 324 | 183 | | 2,100 |
| 1961 Lambda 2 | Capsule | 8 Apr. 61 | 97.8 | 682 | 126 | | 300 |
| 1961 Nu 1 | Explorer XI | 27 Apr. 61 | 107.9 | 1,113 | 302 | 108.058 | 82 |
| 1961 Omicron 1 | Transit 4A | 29 Jun. 61 | 103.8 | 620 | 547 | | 175 |
| 1961 Omicron 2 | Injun-Greb | 29 Jun. 61 | 103.8 | 619 | 548 | 136.5; 108.09 | 95 |
| 1961 Pi 1 | Discoverer XXVI | 7 Jul. 61 | 92.6 | 352 | 142 | | 2,100 |
| 1961 Rho 1 | Tiros III | 12 Jul. 61 | 100.3 | 511 | 457 | 108; 108.03 | 285 |
| 1961 Sigma 1 | Midas III | 12 Jul. 61 | 161.5 | 2,197 | 2,084 | | 3,500 |
| 1961 Upsilon 1 | Explorer XII | 16 Aug. 61 | 1,593 | 48,059 | 183 | 136.020 | 83 |
| 1961 Omega 1 | Discoverer XXX | 12 Sept. 61 | 91.9 | 306 | 144 | | 2,100 |
| 1961 Alpha Beta 1 | Discoverer XXXI | 17 Sept. 61 | 91 | 202 | 138 | | 2,100 |

Decayed Satellites[4]

| Designation | Name | Launch | Decay | Weight in Orbit[3] (Lb.) |
|---|---|---|---|---|
| 1961 Xi 1 | Discoverer XXV | 16 Jun. 61 | 12 Jul. 61 | 2,100 |
| 1961 Pi 1 (Discoverer XXVI) | Capsule | 8 Jul. 61 | 9 Jul. 61 | 300[5] |
| 1961 Tau I-USSR | Vostok II | 6 Aug. 61 | 7 Aug. 61 | 10,430[5] |
| 1961 Phi 1 | Ranger I | 23 Aug. 61 | 30 Aug. 61 | 675 |
| 1961 Chi 1 | Explorer XIII | 25 Aug. 61 | 28 Aug. 61 | 187 |
| 1961 Psi | Discoverer XXIX | 30 Aug. 61 | 10 Sept. 61 | 2,100 |
| 1961 Psi 1 | Capsule | 30 Aug. 61 | 4 Sept. 61 | 300[5] |
| 1961 Omega 1 (Discoverer XXX) | Capsule | 12 Sept. 61 | 15 Sept. 61 | 300[5] |
| 1961 Alpha Alpha 1 (Mercury) | Capsule | 13 Sept. 61 | 13 Sept. 61 | 2,700[5] |

Notes: [1] Orbital elements of solar satellites are given in Astronomical Units, approximately 93 million mi.; [2] Frequencies given only for satellites still transmitting; [3] Orbital weight includes structures and instruments; [4] Satellites which have decayed since last publication of Space Vehicle Log (AW Aug. 7, p. 61), which contained complete record through July 1, 1961; [5] Successful re-entry and recovery. U. S. has launched all satellites except those noted USSR.

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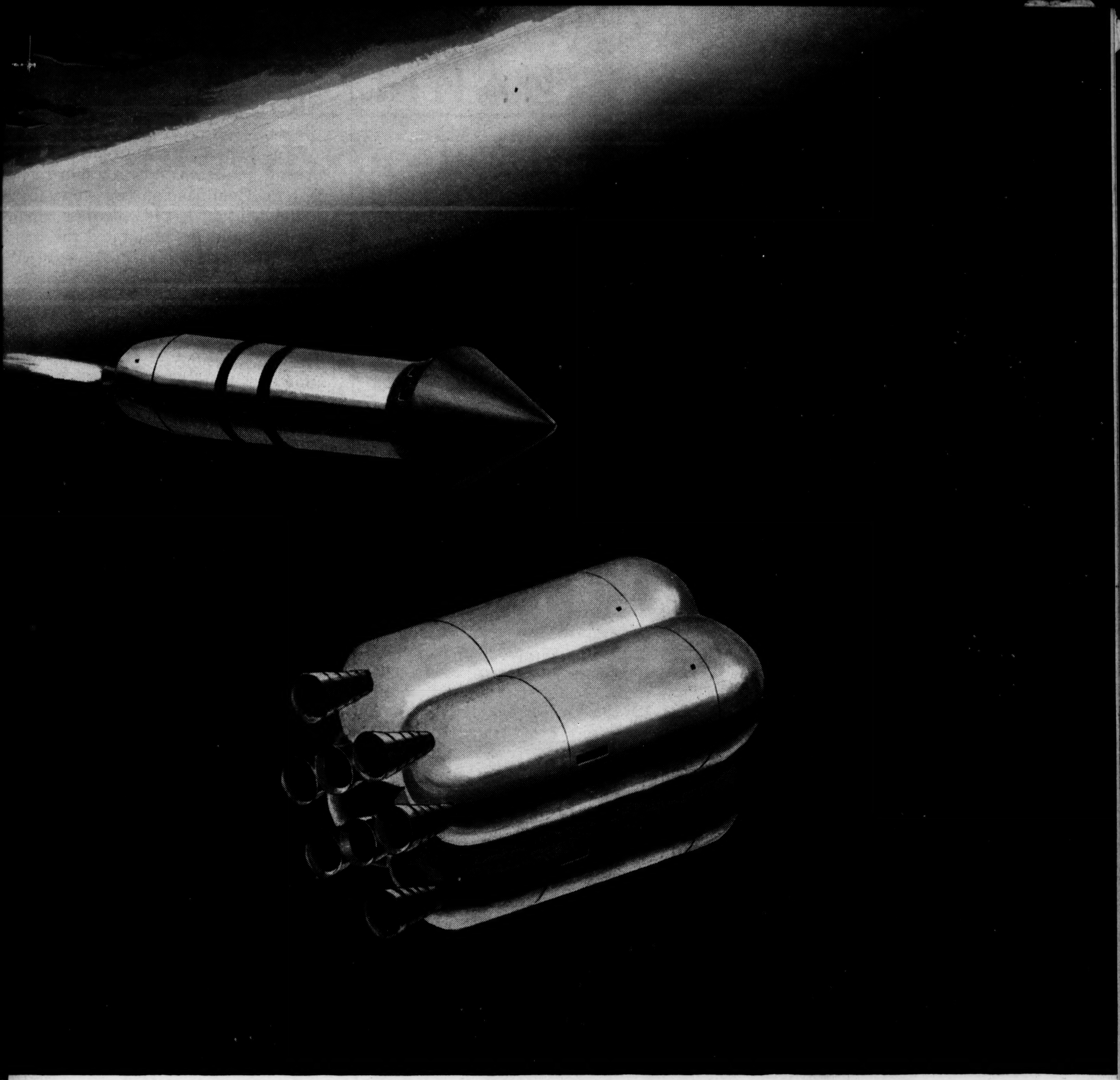
Sources: National Aeronautics and Space Administration Space Operations Control Center, North American Air Defense Command (Norad), and Smithsonian Astrophysical Observatory (SAO).

# *Raytheon brings proven guidance and*

Three techniques are currently available to meet the challenge of Space Rendezvous Guidance radar, infra-red and optics. Of these techniques, radar has been used for homing guidance system to the greatest degree. Studies by Raytheon, whose radar experience spans three decades have indicated that continuous wave radar possesses these desirable characteristics:

- No minimum or 'blind' ranges
- Greater range for a given weight
- Simple FM Techniques for ranging
- Direct and accurate velocity readings
- Ease of acquisition
- Greater simplicity and reliability



# sensor capability to space rendezvous

The experience gained from the inertial guidance system for the advanced Polaris, coupled with the proven success of the Hawk and Sparrow C W homing systems give Raytheon the most extensive proven capability applicable to the space rendezvous guidance problem.

In addition, Raytheon, one of the world's largest scientific-industrial organizations, has proven its ability to manage every phase of a complex system — from early study and design through development, production and field support of operational systems and equipment.

*Missile and Space Division, Bedford, Massachusetts*

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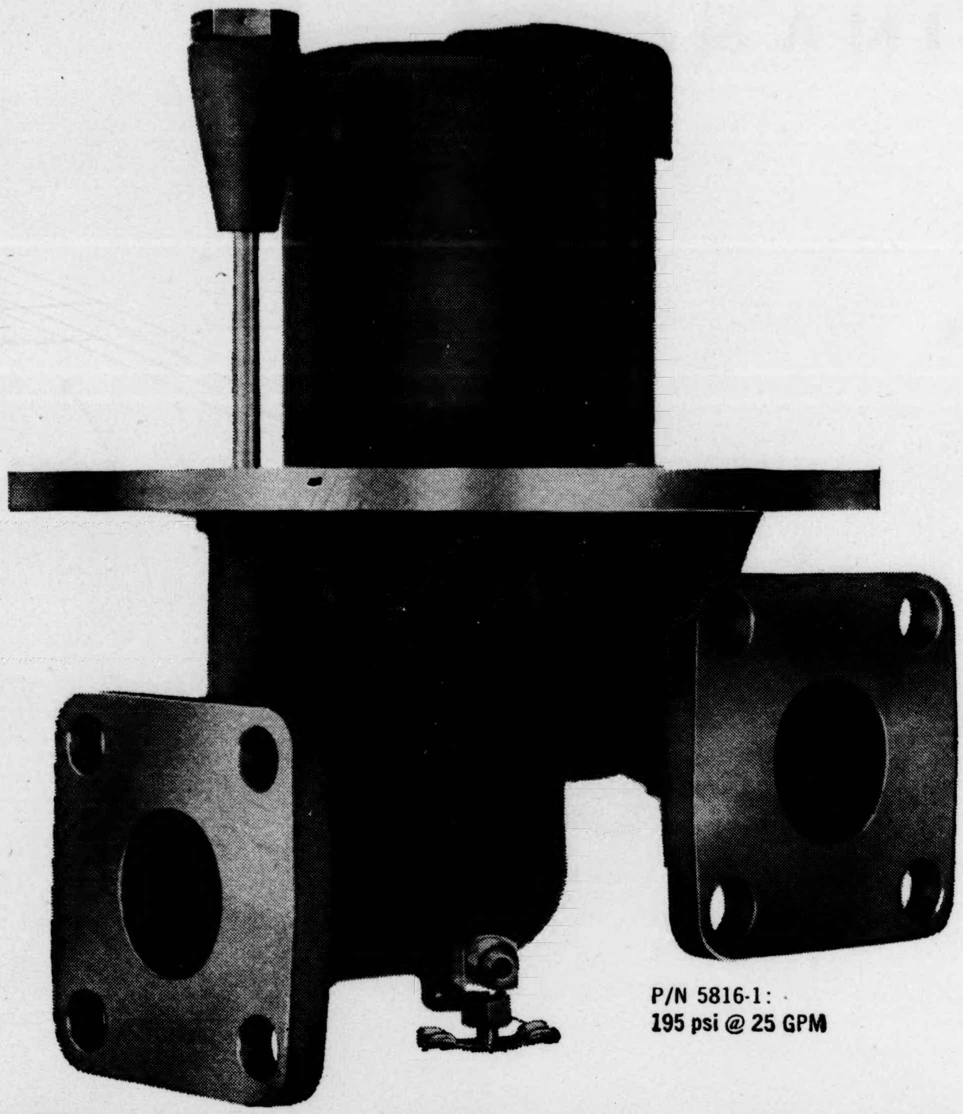

P/N 5816-1:
195 psi @ 25 GPM

FROM TASK — THREE NEW DIELECTRIC COOLANT PUMPS

Three unique design concepts enable Task's FC-75 pumps to realize unprecedented efficiencies for their small size. Exclusive vapor-cooled motor design* provides the simplicity of seal-less construction without incurring viscous and churning losses common to the submerged motor. Hydrodynamic performance is enhanced by utilizing an integral inducer-impeller. A novel internal boost system* assures cavitation-free performance even when reservoir pressure approaches that of the fluid vapor pressure. Combined with sound design and careful manufacture, these innovations result in exceptionally fine pumps.

For further details on Task's dielectric coolant pumps, phone PRospect 4-3100 or write:
Task Corporation, 1009 E. Vermont Ave.,
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P/N 5792-1:
135 psi @ 7 GPM

P/N 3970-7:
30 psi @ 2 GPM

TASK

*PAT. PEND.

## USAF Life Sciences Shift Is Due Jan. 1

**Washington**—Air Force has decided to shift bioastronautics research to the Systems Command in two steps, to be completed Jan. 1, 1962, because administrative problems prohibited the transfer by Oct. 1 as originally planned (AW Sept. 25, p. 73).

Brig. Gen. Theodor Bedwell, Jr., assumed command of the newly-activated Aerospace Medical Division on Nov. 1. This new division, the sixth major operating division in AFSC, now consists of the Aerospace Medical Center at Brooke AFB, Tex., and the Arctic Aeromedical Laboratory at Fort Wainwright, Alaska. Both facilities were transferred to AFSC from Air Training Command.

Elements of the Aerospace Medical Center involved in the transfer are the School of Aerospace Medicine, the Lackland AFB Hospital, 6570th Epidemological Laboratory at Lackland, and the 6570th Air Base Group at Brooke. Formerly under the Aerospace Medical Center, and remaining with Air Training Command, is the Medical Service School at Gunter AFB, Ala.

On Dec. 31, the Aerospace Medical Center will be abolished, and the Aerospace Medical Division will consist of eight major organizational elements. They will be the School of Aerospace Medicine and the 6570th Air Base Group at Brooke; Lackland AFB Hospital, Personnel Laboratory and 6570th Epidemological Laboratory at Lackland; Aerospace Medical Laboratory at Wright-Patterson AFB; Aeromedical Field Laboratory at Holloman AFB, and the Arctic Aeromedical Laboratory at Wainwright.

Other divisions in AFSC are Space Systems, Ballistic Systems, Aeronautical Systems, Electronic Systems and Foreign Technology.

## Thermoelectric Alloy Effective at 900C

Germanium-silicon alloy which offers important advantages as a thermoelectric material has been developed at RCA's David Sarnoff Research Center under a research program initiated by Navy's Bureau of Ships.

RCA says the new material is most effective in the temperature range between 350C and 900C; those figures include the temperatures of useful heat output from nuclear reactors (about 550C) and gas flames (about 900C). Advantages over currently used lead-telluride thermoelectric materials include higher power density—about four times that of the conventional material—and stability at high temperatures.

# FINANCIAL

# Raytheon Expects Slower Growth Rate

By James D. Hendricks

New York—Annual growth rate of 7% to 8% during the 1960s, slowing considerably from the pace of the last 10 years, will build a total electronics volume between $18 and $20 billion by 1970, Richard E. Krafve, president of the Raytheon Co., predicts.

Total government 1961 spending within electronics companies will reach $7 billion, including related non-electronic missile and space expenditures, Krafve believes. By 1970, he estimates government electronics spending at $10 billion and another $4 billion for non-electronic missile and space programs.

Discussing his own company and the future of the entire field at a recent meeting of the New York Society of Security Analysts, Krafve noted that the field "is entering a new phase . . . an era in which its products, new concepts, new technologies—while still vitally important—will not be enough for continued success and growth."

He said electronics firms are beginning to mature, and the future belongs to those companies that have, in addition to a breadth of engineering, the manufacturing and marketing skills and management capabilities to compete against the biggest and the best.

The picture in the coming decade will be highlighted by elimination or absorption of most of the 3,500 companies now involved in various aspects of electronics, Krafve said, and the emergence before 1970 of seven or eight large integrated firms producing a wide variety of components and complete systems.

"The inevitable economic trend away from small companies specializing in one field already is beginning," the Raytheon president said. "In the semiconductor field, this same trend is accelerating so rapidly that soon it appears likely that relatively few companies will be making transistors exclusively. All indications are that the large volume of semiconductor production will come from integrated electronic companies."

### Semiconductor Problems

Profit problems currently plaguing the semiconductor field probably will continue for the next six-nine months, Krafve said, and must be faced by mid-1962.

He cited recent decisions by CBS Electronics and Rheem Mfg. Co. to sell their semiconductor subsidiaries as a solution many firms will select. Raytheon acquired CBS Electronics' semiconductor plant at Lowell, Mass., last June and last month said it will purchase assets of Rheem Semiconductor Corp., Mountain View, Calif.

Development of solid circuits based around thin film and other exotic techniques to some extent "sounds the death knell of the manufacturer making just semiconductors and selling them to someone else who puts them into a system," Krafve said. "We don't feel the equipment and system designers will be satisfied with the standard types of circuits—with which they would have to be satisfied—off someone else's production line."

Raytheon's move into the microelectronic field is aimed at strengthening its position in systems and secondarily aimed at producing a marketable product. "These types of thin film techniques based around solid state devices will be manufacturing techniques adopted by the system manufacturers as time goes on, and we feel our course is to aim that way, to a great extent, at the start," he said.

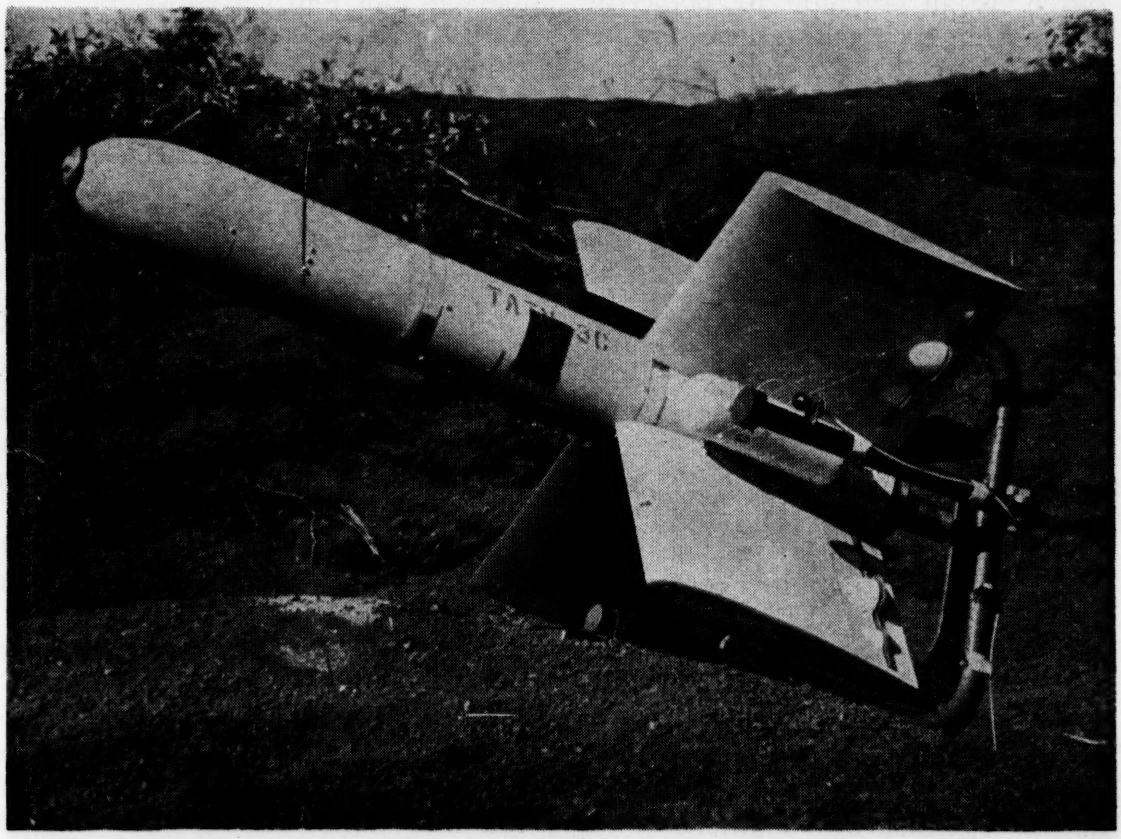
Although Raytheon's volume has leveled over the last two years at approximately $540 million, Krafve explained that emphasis on creating strong product positions in each of its 13 divisions and boosting of the company-initiated research and development program, started in 1958, to about $13 million this year already have begun paying off. As an example, he pointed out that 35% of total 1961 sales for one of the divisions will result from products not in production in 1959.

Rigid cost reduction and control programs throughout the company have produced substantial savings, Krafve remarked, particularly in manpower, which represents 50% of the firm's total cost. He reported a manpower reduction of 2,400 during the 18 months prior to last September—primarily clerical, administrative and indirect personnel.

Raytheon is a line and staff organization, with each division holding both specific product line responsibility and the authority necessary for meeting its requirements, Krafve said. The firm's staff is composed of a consulting and advisory group capable of applying special skills to divisional problems. In basic disagreements, neither group can overrule the other.

"If the problem cannot be resolved, it moves up the line and, if necessary, reaches me where a decision is made," the Raytheon president added. "The knowledge that I will make the decision promptly usually results in the problem being resolved at the first stage."

With new and better facilities, technology and management now in operation, Krafve said, the company is confident that its rise in earnings, which progressed through the second and



**Japanese Develop Anti-Tank Missile**

**Development of Japanese MAT wire-guided, solid-propellant anti-tank missile is nearing completion by Kawasaki Group. Japanese Self-Defense Agency has ordered 930.**

third quarters of 1961, is indicative of accelerating profits. Over-all Raytheon objective is to earn 3% net profit on sales, and Krafve said the company is aiming for a 2% profit in 1962. Sales next year are expected to top $600,000,000.

"Raytheon plans to increase its market penetration to a total government volume between $800 and $900 million by 1970," Krafve told the analysts, adding that the figure might be conservative. "Our 40% capture rate on new proposals this year is unusually high, but even at a lower, more normal rate, we believe that we can reach our goals."

The Raytheon executive said that concern over possible severe defense cutbacks eroding much of Raytheon's financial structure is understandable, since defense programs represent a dominant portion of company volume. But he noted that no substantial change in present major programs, including the Navy Sparrow air-to-air guided missile and Army's Hawk air defense missile, is foreseen and future programs appear solid, with gradual increase in sales.

Summing up 1961 financial status, Krafve said that sales should run about $550 million, with fourth quarter totals higher than those of the third. No drastic inventory writeoffs are planned, he added.

# Harvard Professor Urges Easing Of Government Airline Regulation

**Hartford, Conn.**—Airline overcapacity problems and their ensuing economic consequences are typical of any rapidly growing industry, in the opinion of Dr. John R. Meyer, professor of economics at Harvard University.

Unlike other industries—semiconductor manufacturers, for example, which currently are going through the same sort of growing pains—the airlines are federally regulated, and Dr. Meyer warned against succumbing to a temptation common to a regulated industry. That is seeking through temporary political expedients to avoid the financial suffering entailed in a natural rectification of excess capacity.

"Temporary alleviation," he said, "often is an attempt to perpetuate escape from economic reality. Airlines should consider the history of railroad regulation in its efforts to escape economic reality through short-run palliatives."

Not all short-run measures are to be avoided, he said at an aviation symposium here sponsored by the Connecticut General Life Insurance Co. Some are consistent with what should be the long-term objective of the industry: open competition in the major markets.

## Competitive Tools

"Airline management is not being given the tools to work in a competitive environment," he said. "There should be a substantial reduction in regulation, especially in the areas of service and rates. The Civil Aeronautics Board should set out general limits—broad maximums and minimums—and let the carriers seek their own solutions."

Other possibly useful immediate steps he proposed:

- **Relaxation of regulatory bias** toward mergers. Though competition among the few leaves economists uneasy, he said, good performance probably could be ensured by maintaining at least the latent possibility of new entry into the market. In air transport, this might be done by CAB reserving the right to grant licenses for domestic operations to international carriers.
- **Clarification of status** of certain trunklines. Two or three of the trunklines are operating not only in the major markets, but also in those occupied by the local service carriers and in what might become the markets of the third level carriers currently being postulated.

## Four Categories

Dr. Meyer broke down air transport markets into four categories:

- **First level,** comprising the 100 largest airports and their related city pairs which are large enough to support economic and efficient service by more than one airline.
- **Second level,** composed of the next 100-150 largest airports and city pairs which can support an economic service by only one carrier. This is the category described as "natural monopoly."
- **Third level,** the remainder of the 500-550 airports in the U. S. receiving commerical air service and which at present cannot support economic service by one carrier.
- **Private market,** which includes aircraft operated by corporations in company business.

In respect to private flying, Dr. Meyer raised a controversial point—what he termed a subsidy to private flying due to imbalance in user charges for airport and airways use between common carriers and private aircraft. Fuel taxes, such as those proposed in the last session of Congress, would only increase this discrimination, he said.

To eliminate this imbalance, Dr. Meyer recommended dropping the 10% federal transportation tax, increasing airport charges to a compensatory level and gearing them to number of landings and takeoffs rather than size of aircraft, and developing a two-part tariff to recoup federal airway costs—one part a general licensing fee and the other a fuel tax.

## Third Level Carrier

Development of a third level class of carrier (AW Nov. 13, p. 44) to serve smaller communities was favored by Dr. Meyer as the best solution if subsidized service to such communities is to be continued.

To establish such a third level subsidy, he proposed putting it on an open bid basis. The government agency would establish a set of specifications dealing with quality and frequency of service, type of equipment and rates for different blocks of points. Then the agency would ask for bids.

Eventual aim for the second level market, once the third level carriers are created, would be to make it the exclusive province of subsidy-free local service carriers, operating in a natural monopoly environment with conventional public utility type of regulation, Dr. Meyer said.

This goal is beset with complications, he said, and attaining subsidy-free operation by local carriers would involve their adjustment of equipment—now often too complex and luxurious for this market—of operating frequencies, and transfer of routes in present cases where the second level markets may now be served by more than one carrier, particularly combinations of one local service carrier and one trunkline.

## Difference of Opinion

**Federal Aviation Agency Administrator Najeeb E. Halaby and his predecessor, Elwood R. Quesada, crossed swords over organization of the FAA during the Connecticut General Aviation symposium.**

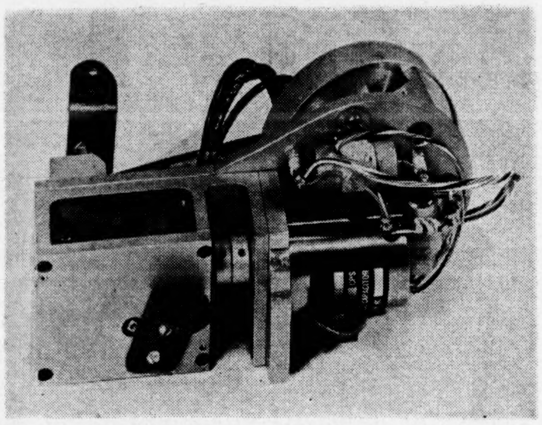
**Halaby, one of the speakers, had said there was now to be only one FAA, not four—a reference to the four functional bureaus into which Quesada had organized the agency.**

**This remark was offered to Quesada for comment during a panel he moderated at a later session. Expressing surprise, Quesada replied:**

**"FAA is now going to a program where there will be eight FAAs—we can only assume eight are better than one—to a regional system where the regional administrators will have the same perogatives and authority as the administrator. This is called sophisticated management."**

**Quesada said he called it bureaucracy.**

# NEW AEROSPACE PRODUCTS



## Cockpit Voice Recorder

Continuous loop recorder developed by Lockheed Aircraft Service, Inc., has been ordered by Qantas Empire Airways for installation on that carrier's fleet of Boeing 707s and Lockheed Electras.

The LAS Model 134 recorder, which retains a record of the most recent hour of cockpit, radio and interphone conversation, uses a $\frac{1}{4}$ in. magnetic tape at $1\frac{7}{8}$ ips. without special equipment. The unit provides four-track recording with record heads pre-aligned and requires no field adjustment. Plug-in modular components are available for field replacement without special tools.

Adjustable filters eliminate background noise and aircraft vibration pick-up. The system includes a go-no go indication of proper operation and operates on standard aircraft power. The recorder can be installed as an integral part of the Lockheed 109-C flight recorder, already on the market, or can be installed separately by airlines or other users desiring a virtually indestructible radio rack or other self-insulated unit, the manufacturer states.

**Special Devices Division, Lockheed Aircraft Service, Inc., Ontario International Airport, Ontario, Calif.**

## Miniature Geared Dial

New $3\frac{1}{16}$ in. square by $1\frac{5}{16}$ in. deep Mini-Dial is designed for use as a mechanical gain control for autotransformers, tuning coils, capacitors and function generators, also can be applied as an angular positioner for synchros and resolvers.

Mounted over any shaft extending from a panel, the Mini-Dial construction is said to pass environmental extremes. Completely geared, it drives loads of high breakaway torque without backlash. Operation reportedly is quiet, and no lubrication is necessary.

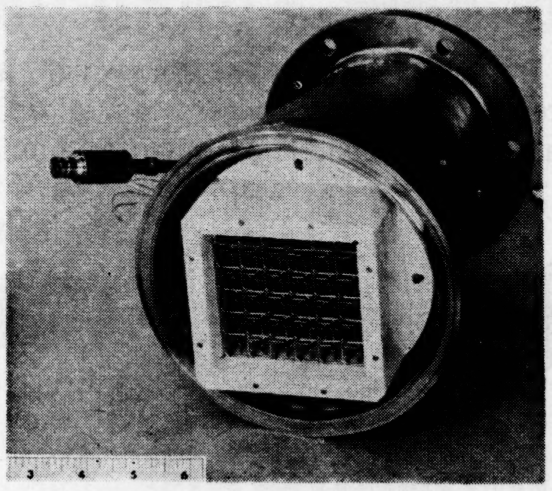
Scales may be chosen with markings of 0-360 deg., ± 180 deg., 0-100, or 0-6,400 mils. Graduation accuracy reported at 12 min.-of-arc. Coarse knob ratio is 1:1, fine knob ratio 100:1.

**Theta Instrument Corp., 520 Victor St., Saddle Brook, N. J.**

## Cryogenic Quality Meter

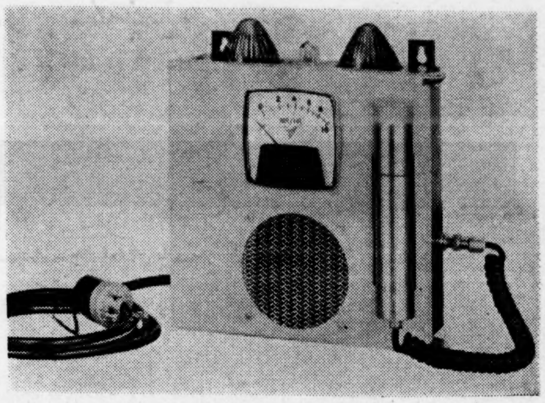
Automatic instrument continuously measures fluid quality in two-phase cryogenic flow systems.

Operation is based on the determination of dielectric constants of the liquid and of the vapor in two-phase fluids such as liquid hydrogen, liquid nitrogen and liquid oxygen. The instrument provides a continuous indication of per cent vapor, by volume, over 0-100% with an accuracy of 1% full scale and within 1 db. to 400 cps.



Readout appears on a control panel meter which includes provisions for driving a strip chart recorder, high speed oscillograph or oscilloscope. The instrument consists of two major subassemblies, a pipe test section and an electronics rack.

**Allied Research Associates, Inc., Industrial Products Dept., 43 Leon St., Boston 15, Mass.**



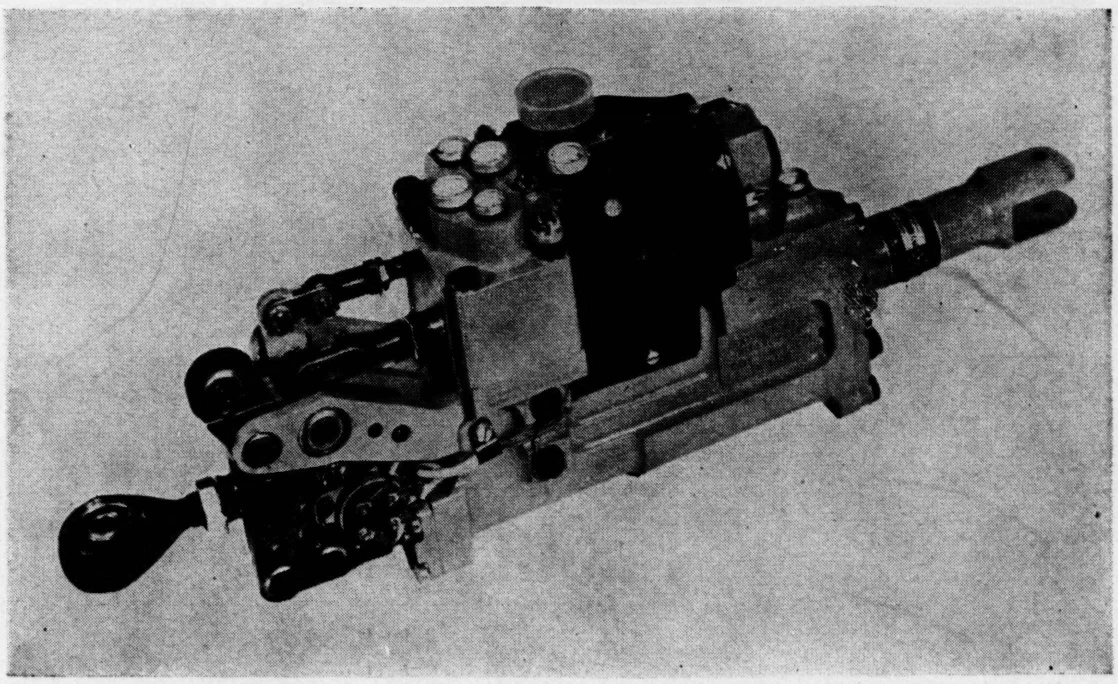
## Beta-Gamma Monitor

Self-contained beta-gamma radiation monitor, designated Model EP-511 VAMP, is designed for use in any area where radioactive materials are stored or handled. The instrument, intended for 24-hr. operation, can be preset to sound a loud warble tone and/or flash a light whenever radiation exceeds any specified level. An amber fail-safe warning light indicates circuit or detector malfunctions.

The portable monitor is enclosed in a dust-tight metal housing for wall mounting or free-standing use. It is available with a built-in detector or an external detector connected to the housing by a flexible coil cable.

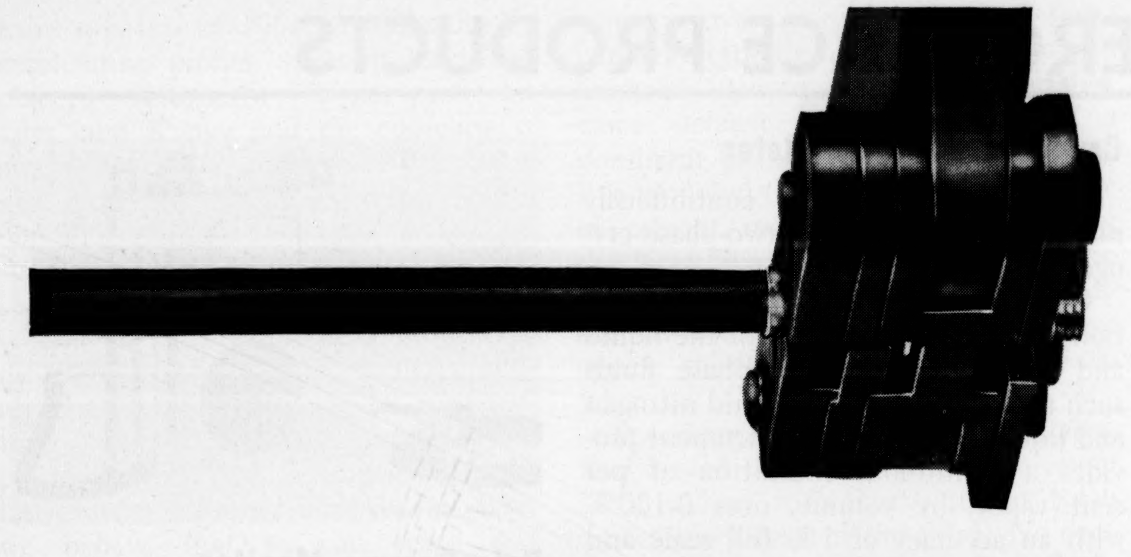
The instrument has a completely transistorized circuit which is internally adjustable to sound the alarm at any point from 20-100% full scale with an accuracy of 10% of the indicated reading.

**Victoreen Instrument Co., 5806 Houge Ave., Cleveland 3, Ohio.**



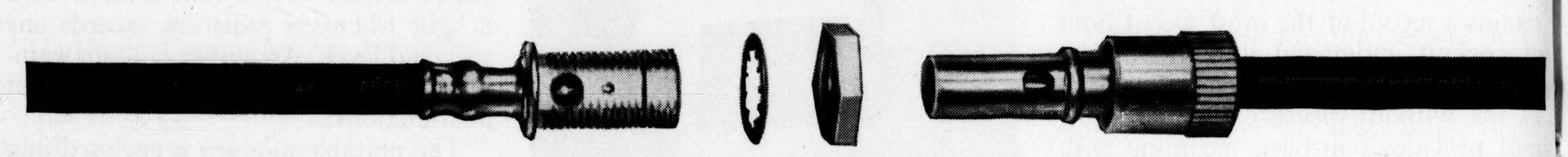
## Hydraulic Power Control Units

**Three hydraulic power control units, developed for Hawker Siddeley by the Hydraulics Division of Fairey Engineering, Ltd., provide power for ailerons and tailplane of the Hawker P.1127 VTOL strike fighter, now undergoing transition tests in Great Britain. Units are tied to automatic stabilizing computing system, with any tendency toward pitch, yaw or roll sensed by rate gyroscopes and signalled through electro-hydraulic control systems to the hydraulic jacks. Each unit also can accept the usual direct inputs from the pilot; a number of P.1127 transitions have been made with manual control.**



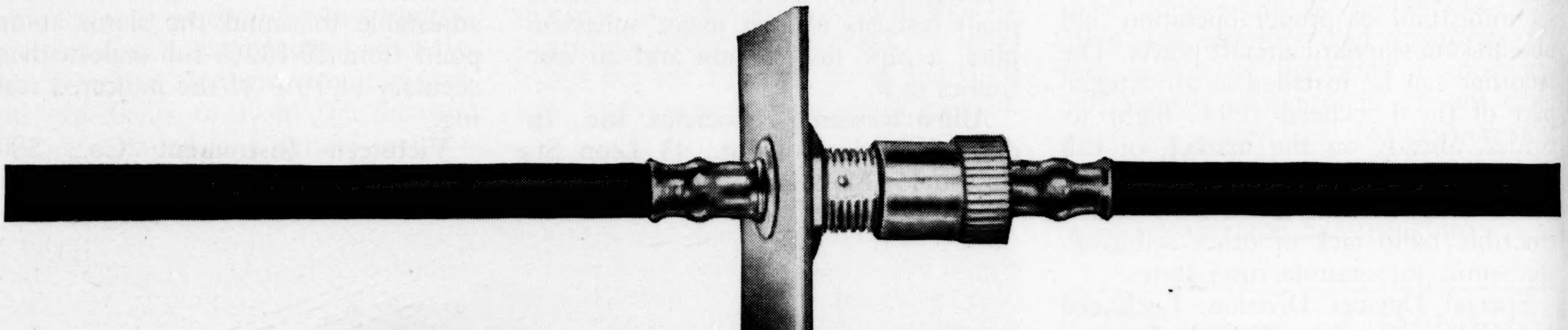
# TAKE AMP COAXICON®

the only coaxial cable connector which attaches to both center conductor and outer braid with ONE CRIMP of the matching, precision-controlled crimping tool.



# ADD HARDWARE

a lock nut, a lock washer and plug retaining unit.



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the only threaded nut coaxial connector for through panel installations which can be attached to both inner conductor and outer braid with ONE CRIMP of the matching AMP tool.

**RESULT** A more than fifty percent saving over other coaxial connector assemblies, even lower installed cost when compared to soldering —plus the extreme reliability created by the AMP solderless termination technique . . . the best in the business! Complete information will be sent on request.

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# All-Weather Capability Studied for 707

**Seattle**—Details on a joint Boeing-Bendix program to improve the all-weather capability of the 707/720 jet transports were disclosed here to representatives of 17 airlines now operating the aircraft, and to the Air Force, at a three-day symposium.

The symposium, sponsored by Boeing Co.'s Transport Division, described the company's three-phase program whose ultimate goal is to provide the capability for transport aircraft to operate in zero/zero weather. More immediate objectives are intended to achieve 200 ft., .5 mi. minimums followed by lower minimums, of perhaps 100 to 125 ft. and .25 mi. (AW Nov. 6, p. 33).

Boeing analysis of the weather problem presented at the symposium illustrates why there is considerable current airline interest in reducing jet transport minimums. In the U. S., for example, there is an average of 144 hr. per year when jet minimums of 300 ft., .75 mi. prevail, compared with only 70 hr. for prop-driven aircraft minimums of 200 ft., .5 mi. This means that diversion or cancellation occurs twice as often with jets as with the older aircraft.

Figures for weather minimums on a global basis show an even higher percentage of adverse weather conditions, which explains in part the keen interest of international carriers in improving jet transport adverse-weather capability.

## Present Minimums

With present jet minimums of 300 ft. and .75 mi., significant gains in airline revenue can be obtained from a modest investment in improving airplane and autopilot performance, Boeing's studies indicate. The crossover point, where the cost of additional equipment, improvements and related expenses required to achieve lower minimums equals economic gain is somewhere below 200 ft. and .5 mi., although the precise numbers cannot be firmly fixed at this time. Beyond this point, the cost of pushing minimums down to the ultimate of zero-zero landing rises rapidly while the economic benefits to the airlines do not keep pace. (See chart p. 93.)

One aim in the Boeing symposium was to apprise airlines of this fact and to clarify Boeing's aim in the program, which is to study the problem, monitor the systems developed in the U. S. and abroad and to continue to improve present equipment. Boeing emphasized to Aviation Week that it does not want to get into the position of developing a costly system which would be forced upon the airlines by competition or regulation. This assurance to the carriers was one reason for conducting the symposium.

At the same symposium, Eclipse-Pioneer Division of the Bendix Corp. outlined a program which it will follow to improve performance and reliability of its autopilot systems in the 707/720. Aim of the autopilot improvement program is similar to that of the aircraft program in that efforts at reducing minimums will be directed toward the final goal of providing a blind landing capability. (For Bendix program details see p. 94. Lear proposal is on p. 99.)

## Realistic Minimums

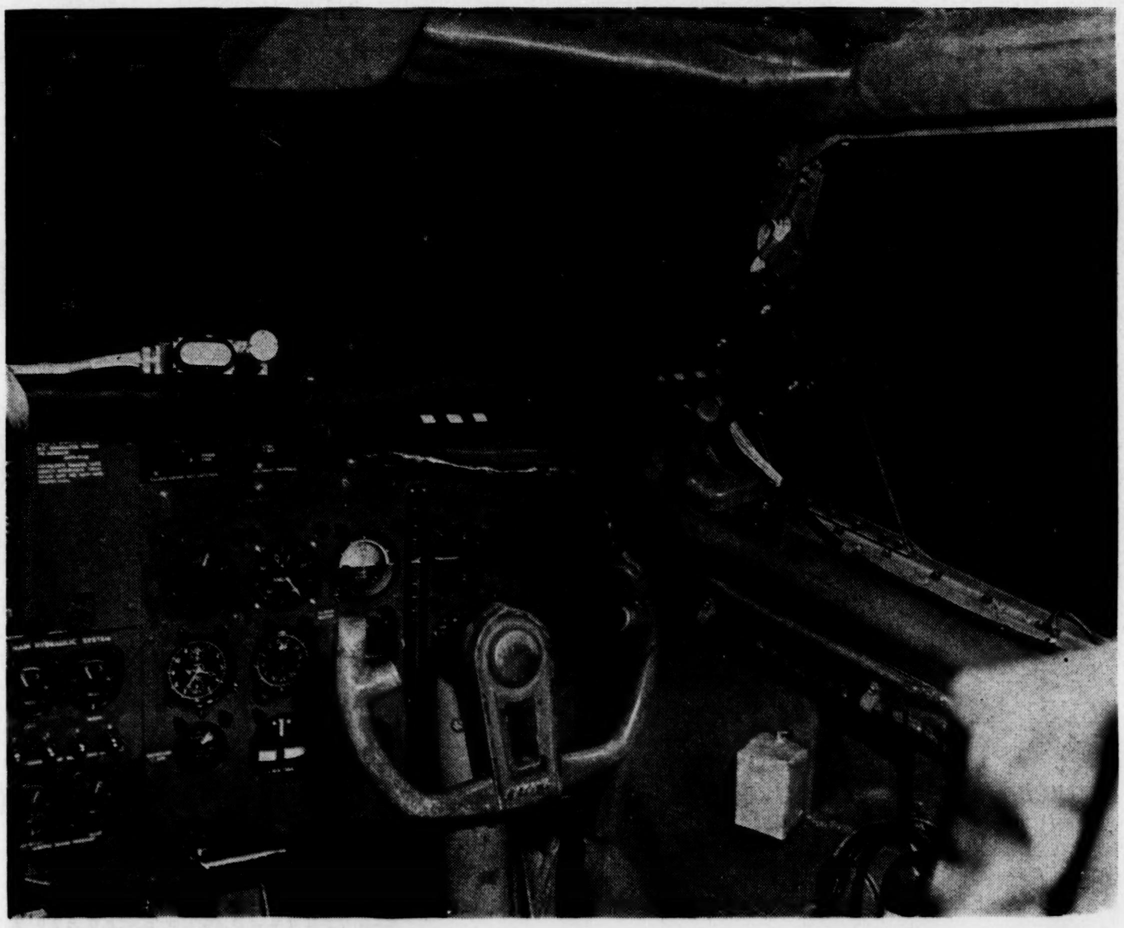
Most participants in the symposium agreed that minimums of 200 ft. and .5 mi. are realistic with the present equipment providing the reliability and performance of the equipment is brought up to a higher standard.

Air Line Pilots Assn., however, indicated in a recent safety forum that approaches below the present minimums of 300 ft. and .75 mi. would be unsafe in jet aircraft without dual approach couplers, dual autopilots and dual flight directors (AW Nov. 6, p. 105). This raises the prospect of another management/pilot dispute when the airlines receive Federal Aviation Agency approval for lowering minimums. ALPA spokesmen have taken a strong stand against any new procedures which might lower minimums for economic or political reasons.

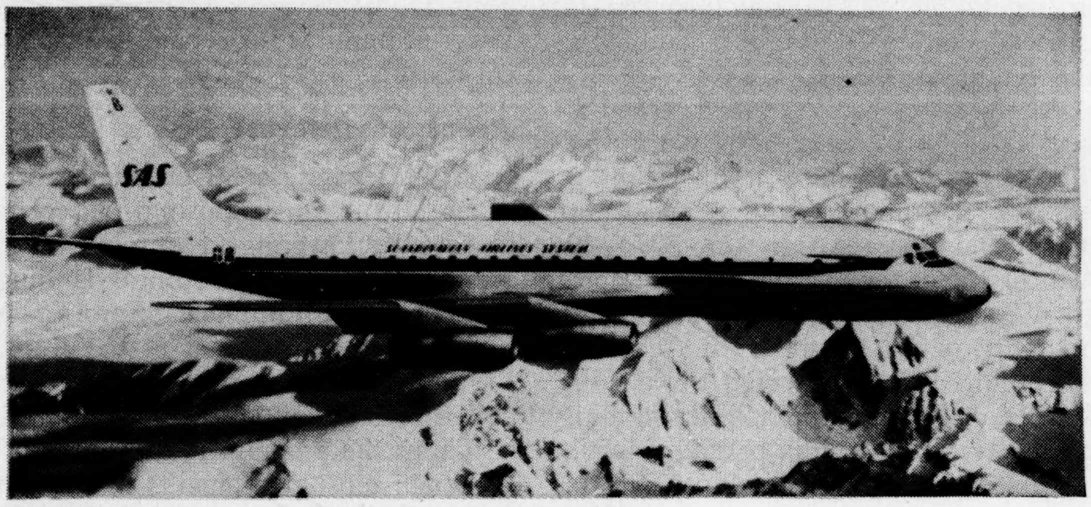
## Areas of Interest

Three separate areas of interest were discussed in the symposium, all related to the safe lowering of minimums and eventual attainment of blind landings:

- **Autopilot performance improvement.** Eclipse-Pioneer Division of the Bendix Corp. has undertaken to improve autopilot reliability and closely monitor the results of the program in airline service. Although most participants in the symposium believe that approaches to 200 ft. and .5 mi. can be made without autopilot, approaches to lower minimums and to eventually blind landings will undoubtedly require automatic flight.
- **Controllability improvements.** Boeing has studied several changes in the 707/720 series aimed at improving controllability mainly in the low speed regime. These changes will be cranked into the production line wherever possible or installed in the field with kits or through service bulletin instructions. The items under consideration are generally minor in nature and can be classed as refinements.
- **Improved landing aids.** New devices now under study by the FAA include a



**BOEING'S 707 instrument panel includes Smith para-visual director system, Lear terrain and rate of descent indicator and AiResearch air data system for all-weather program.**



Rugged transpolar route of Scandinavian Airlines System provides real test for Bendix Doppler on DC-8's.

UNITED
8D
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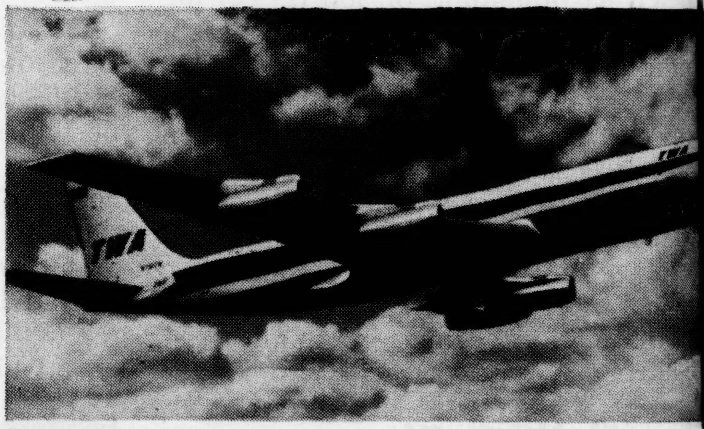
On California-Hawaii runs, Bendix Doppler shows United Air Lines DC-8 Jet Mainliner pilots the most favorable flight paths.

JAPAN AIR LINES

Japan Air Lines DC-8's save time, fuel, and money over the Pole, and across the Pacific with Bendix Doppler's electronic "eyes."



Trans World Airlines is currently testing the Bendix Doppler on transatlantic Boeing Superjet flights.

# Bendix Doppler . . . saving time and

*Every day Boeing 707's, Douglas DC-8's, and Convair 880's displaying the insignia of these eight international air carriers use Bendix® Doppler Navigation Systems to cross the oceans of the world—faster, more economically. Bendix was chosen after extensive test evaluation—subsequently proved out in daily operation under all flight conditions. Over-all records show Bendix systems provide greatest reliability and accuracy—are the easiest Doppler systems to service and maintain. Operation is simplicity itself. Continuous readout of ground speed, drift angle, distance-to-go, and course information make long over-water navigation easier and quicker. For descriptive brochure, write Bendix Radio Division, Avionic Products, Baltimore 4, Maryland.*

**Bendix Radio Division**

THE Bendix CORPORATION

Union Aeromaritime De Transport's DC-8's between Paris and Johannesburg use Bendix Doppler to guide them over the Mediterranean and Africa's barren lands.

Boeing 707 Intercontinentals of El Al Israel Airlines benefit on U. S.-Middle East flights from Bendix Doppler's extra reliability, accuracy.

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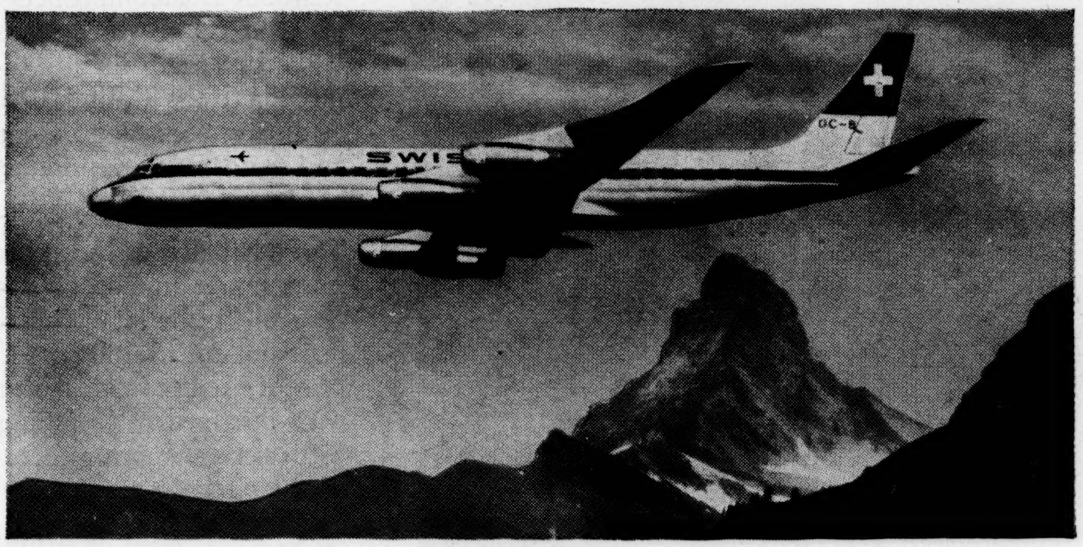
"Mandarin" Convair 880 jets of Civil Air Transport, Formosa, use Bendix Doppler on such long "exotic" runs as Tokyo-Bangkok.



Bendix Doppler "masterminds" Swissair DC-8's on flights between Europe and the United States.

# d money for airlines the world over

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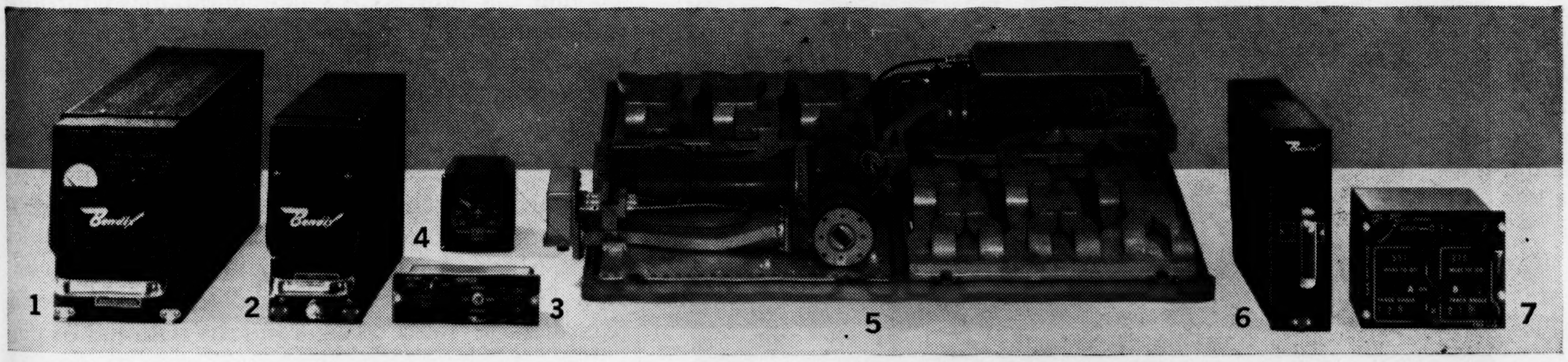
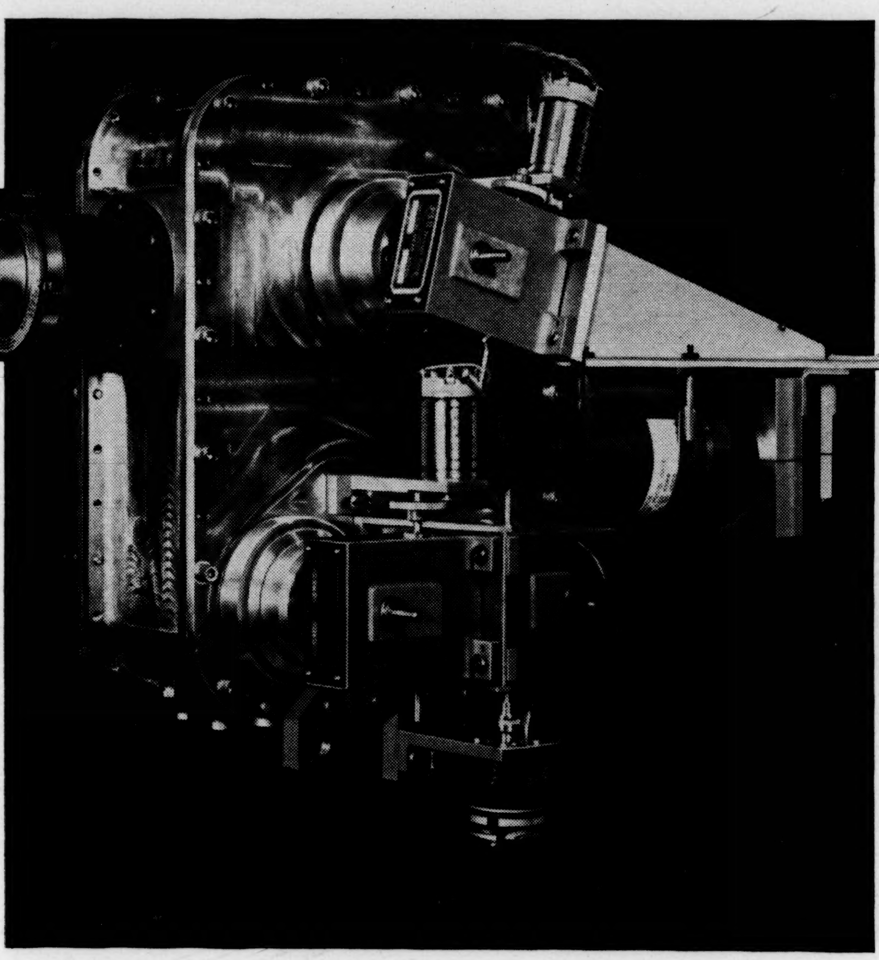


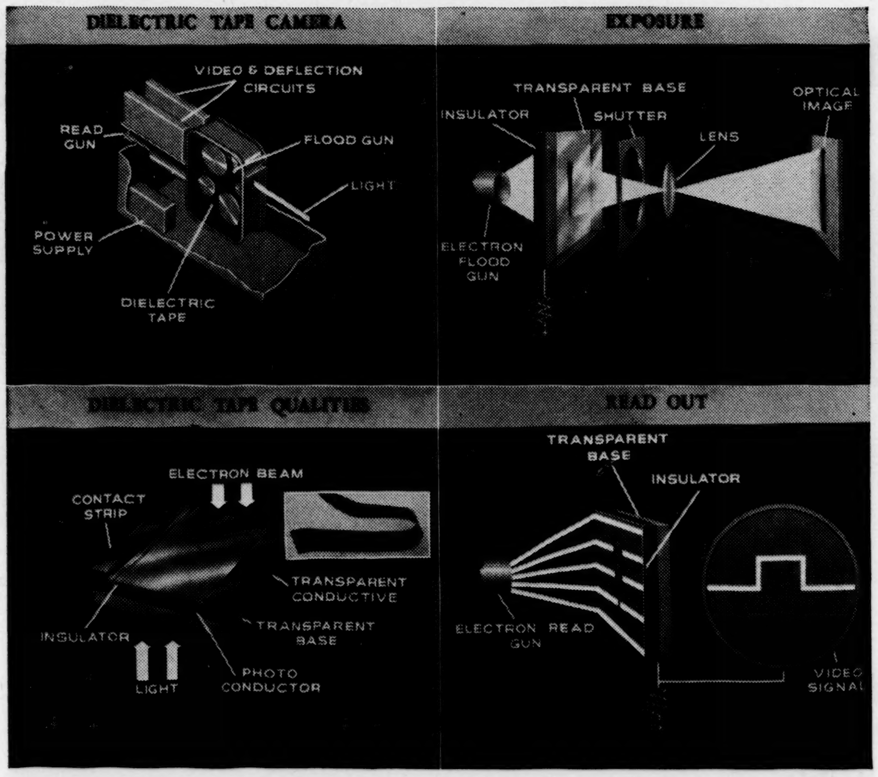
The Bendix Doppler System weighs only 75 lbs. **1.** Tracker Unit. **2.** Transmitter-Receiver **3.** Control Unit **4.** Indicator **5.** Antenna **6.** Nav. Computer **7.** Controller

**West Coast:** Bendix Radio Division, 10500 Magnolia Blvd., N. Hollywood, Calif.
**Canada:** Computing Devices of Canada, Ltd., P. O. Box 508, Ottawa 4, Ontario.
**International:** Bendix International, 205 E. 42nd St., New York 17, N.Y.

# PHOTO-DIELECTRIC TAPE CAMERA SYSTEM

## ...a major advance in space image-sensing




DIELECTRIC TAPE CAMERA
VIDEO & DEFLECTION CIRCUITS
READ GUN
FLOOD GUN
LIGHT
POWER SUPPLY
DIELECTRIC TAPE
EXPOSURE
TRANSPARENT BASE
INSULATOR
SHUTTER
LENS
OPTICAL IMAGE
ELECTRON FLOOD GUN
DIELECTRIC TAPE QUALITIES
ELECTRON BEAM
CONTACT STRIP
TRANSPARENT CONDUCTIVE
TRANSPARENT BASE
INSULATOR
LIGHT
PHOTO CONDUCTOR
READ OUT
TRANSPARENT BASE
INSULATOR
ELECTRON READ GUN
VIDEO SIGNAL

The development of photo-dielectric tape permits the design of a totally new image-sensing system for utilization in satellites and space vehicles. A prototype camera for use with this tape has already been operated and tested. This system, one of the first developed primarily for use in space, offers a number of advantages over existing photographic and television techniques.

Operating on the principle of storing an optical image by converting it to an electronic charge pattern, the photo-dielectric system has inherently high resolution since the picture charge pattern is read out directly as a video signal by an electron beam. Moreover, it offers real promise of providing response in various parts of the radiation spectrum in addition to the visible including infrared and ultraviolet with sensitivity better than standard photographic techniques.

Readout is accomplished by use of a finely focused electron beam which scans the charge pattern. It is then converted directly to a video signal for transmission to the ground. Readout can be accomplished at different speeds to compensate for various power and band-width requirements dictated by the nature of the space mission.

The flexibility of the system permits readout of the same image numerous times, if desired, by ground control. In the laboratory, the same image has been read out up to 100 times without serious degradation of quality. Yet, the image is erased completely, with no trace of "sticking," as the tape is flooded with electrons prior to exposure. Transistorization of the package results in minimum weight and low power requirements.

Since a high vacuum is essential to the operation of a photo-dielectric tape camera system, it is "at home" in the harsh environment of space. Also, dielectric tape is virtually unaffected by radiation thereby eliminating this hazard to ordinary photographic film. It is also reusable and serves as its own storage medium for remote picture-taking sequences.

To find out how RCA's new photo-dielectric tape camera developments can fill your requirements for space image-sensing systems, write to the Manager, Marketing, Astro-Electronics Division, Defense Electronic Products, Radio Corporation of America, Princeton, New Jersey.

And for a challenging, rewarding career in electro-optical systems development, apply to the Employment Manager, RCA Space Center, Princeton, New Jersey. All qualified candidates are considered regardless of race, creed, color or national origin.

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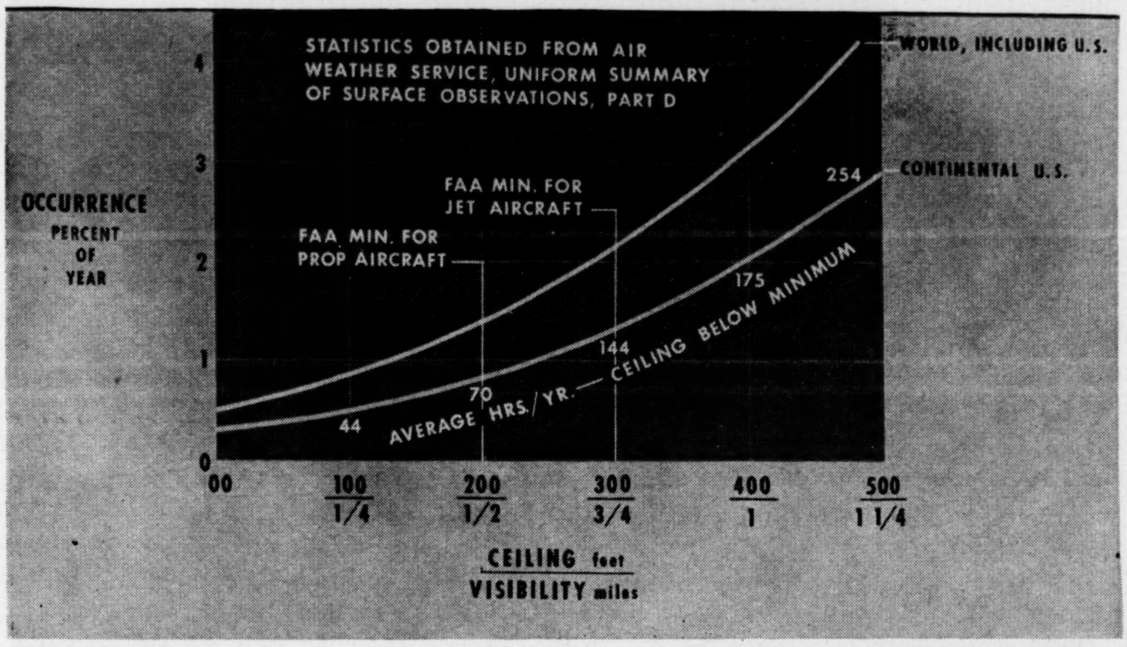
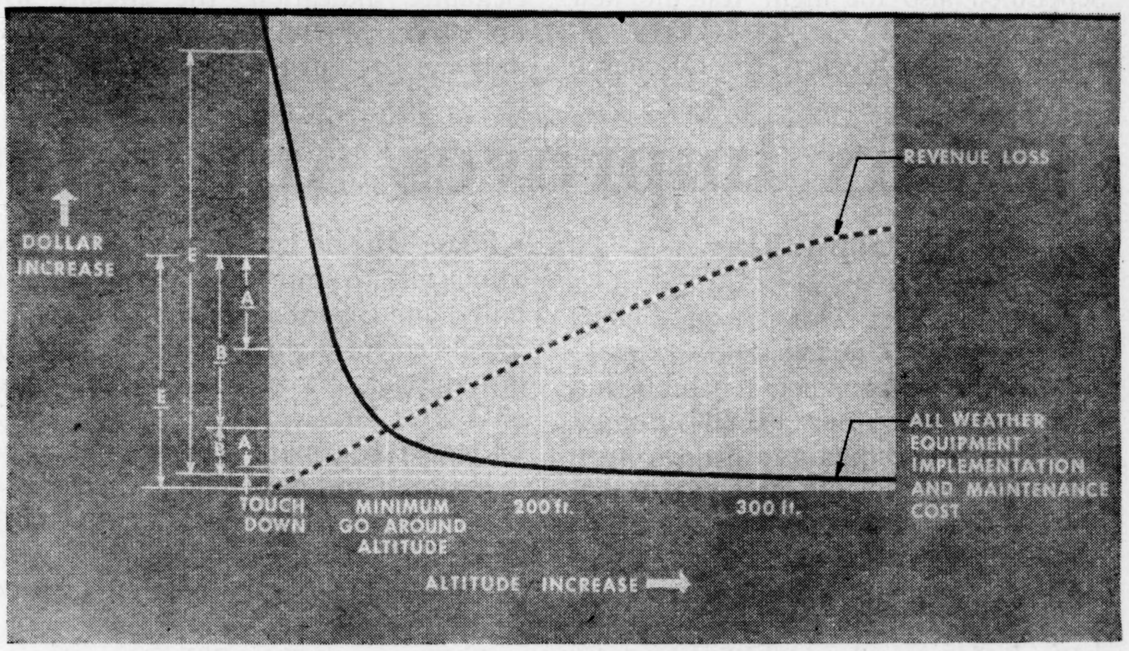


**BOEING STUDY** shows impact of higher minimums for jetliners on airline operations in U. S. and on worldwide basis. For example, jet minimum of 300 ft. and ¾ mile occurs more than twice as often in U. S. as propeller aircraft minimum of 200 ft. and ½ mile, and situation is worse on global basis. Significant economic gain can be achieved with modest-cost improvement of airplane and autopilot to permit lower jet minimums, but somewhere below 200 ft. and ½ mile, the cost of further reduction exceeds economic gain.



directional localizer with considerably improved accuracy. Progress is being closely followed so that such improvements can be integrated with the adverse weather landing capability.

An inherent part of making an aircraft safe for operation in adverse weather is decreasing the possibility of emergencies occurring close to the ground. Boeing has investigated several means of improving controllability by refining control systems.

Pitch control changes involve replacing the pilot's thumb-operated trim switch with one less likely to stick. Also included is the addition of a terminal block in the hub of the control wheel to facilitate changing faulty switches.

Revisions also are planned to the electric trim limit because it has been determined that in some models 3 deg. excess nose up trim was available and 1.3 deg. excess nose down trim was available. An adjustable trim limit switch will eliminate the possibility that a runaway trim will produce more trim than necessary, adding a safety factor in the event of such an emergency. Manual trim will still be available to the present stops.

Elevator trim cutoff is under test to determine the feasibility of installing a device to stop runaway trim without requiring either pilot to remove a hand from the control yoke. On a test basis the device works to disrupt current to the trim system if the control yoke is displaced in a direction opposite to the direction of trim. For example, if the trim system is trimming the aircraft nose up and the pilot combats this with as much as two degrees of forward elevator movement, the trim will cut out. The reverse is true for nose down trim and is designed to eliminate runaway trim with a natural counter-tendency by the pilot. Trim in one direction countered by control movement in the opposite is the situation which would exist in a runaway trim emergency. Tests are being conducted now in determining how much control movement should be required to cut off the trim.

Revisions also are being made to the spoiler system which will prevent asymmetric spoiler deployment in the event of failure. Instead of individual shutoff valves for both spoilers in both wings, there will be one shutoff valve for each set of spoilers outboard and inboard. Modifications also are being made to the aileron trim spring cartridge to permit better lubrication of that part.

Directional control improvements also come in for consideration aimed at eliminating nuisance failures of the yaw damper system. A new rudder power unit is being considered which will include a full-time yaw damper. Thus, yaw damper inputs will be superimposed on the rudder but will not be fed back to the pilot's pedals. Since the new rudder has been made boost limited for all speeds, the need for hydraulic pressure reduction at high speed is eliminated. Also, the dynamic pressure spring is no longer necessary and several other components can be removed or combined resulting in a weight saving of about 40 lb.

### Directional Control

Directional control on takeoff may be made easier with an interconnected nosewheel steering unit coupled to the rudder pedals. This feature, which enables the pilot to keep at least one hand on the control yoke at all times, has found considerable favor with the users of the DC-8. Nosewheel steering authority through the rudder pedals will be limited to 10 deg. and probably will be made proportional to extension of the nosewheel oleo strut.

The usual effect of adverse weather on runway conditions in the form of rain, ice or snow is being considered in development of a modulating anti-skid system which preliminary tests show will increase deceleration rate by as much as 35%. Rather than an "on-off" system such as at present, the modulated system seeks a brake pressure level which is just below the skid point and will apply more or less constant pressure.

Finally, the rain removal system is being improved to be more effective during landing. The greatest need for the system is on landing but since the rain removal system depends on engine compressor bleed air, it becomes least effective when the engines are reduced to idle just before runway contact. Several means are under consideration for increasing the amount of rain removal air available or to effect rain removal and improve visibility by other means.

Federal Aviation Agency and Boeing are conducting a research program probing several areas of interest in lowering landing minimums. The Boeing 707 prototype, the 367-80, will be used in evaluating new instruments and warning systems. Split-axis control—one autopilot for roll, one for pitch—will be evaluated in simulators and flight tests. Either or both may be energized to test pilot reaction to landing by the method wherein the pilot controls either the pitch or roll axis manually and the autopilot controls the other axis. Directional control is afforded by the yaw damper in all cases.

Determination of the maximum allowable offset error for 200 ft. approaches will be made to establish go-around criteria. The initial analysis will be made in a flight simulator with verification being provided by flight tests. Both lateral error and vertical error will be considered along with the possibility of completing the approach under various offset conditions.

Instrument warning systems to provide immediate and positive notification of instrument failures to the pilots will be evaluated in the 707 prototype under the all-weather landing program. Scheduled also for flight test are new instruments:

- **Para Visual Directors (PVD),** developed by Smith Instruments of England, are installed along the lower edge of the windshield in the copilot's position to display roll, pitch and yaw axis information also shown on the conventional flight director instruments. The three indicators resemble striped barber poles, each with the pole axis aligned parallel to the aircraft axis whose information it displays. When flight director is calling for a right bank, for example, the roll-axis PVD striped indicator rotates in this direction. Boeing will evaluate the effectiveness of the PVD display in easing the transition from instrument to visual flight on low approaches.
- **Terrain clearance** and rate-of-descent indicator, a vertical, moving-tape type instrument developed by Lear, will be tested to evaluate an exponential-type flare. The system uses the inputs of a radio altimeter for terrain clearance and by keeping the rate-of-descent indication superimposed on the terrain clearance indication, the aircraft will follow an exponential flareout. The unit can be adjusted to provide a variation in the altitude at which flareout is commenced.
- **Speed command** sensed from angle of attack and displayed on the flight director pitch bar will be tried for usefulness in maintaining proper speed on takeoff and landing. Better performance on takeoff plus the utilization of lower approach speeds are claimed as some of the advantages of the speed control system.
- **Approach thrust command** computer combines the information supplied by the speed command system with delivered engine thrust. Tests will be flown in which both speed command and thrust command will be displayed on the flight director. Net effect is to again utilize lower approach speeds which will result in shorter landing distances.

Eclipse-Pioneer and Boeing also are monitoring the FAA research program on improved directional localizer operation now being installed at Atlantic City, N. J., and the improvements in runway lighting presently under consideration.

# Bendix Improves Autopilot Performance

**By Philip J. Klass**

Eclipse-Pioneer Division of Bendix has launched a three-phase program to increase the performance, reliability and pilot confidence in its PB-20 autopilot and approach coupler as a major contribution to the Boeing program to improve the adverse-weather capability of its 707/720 jetliners.

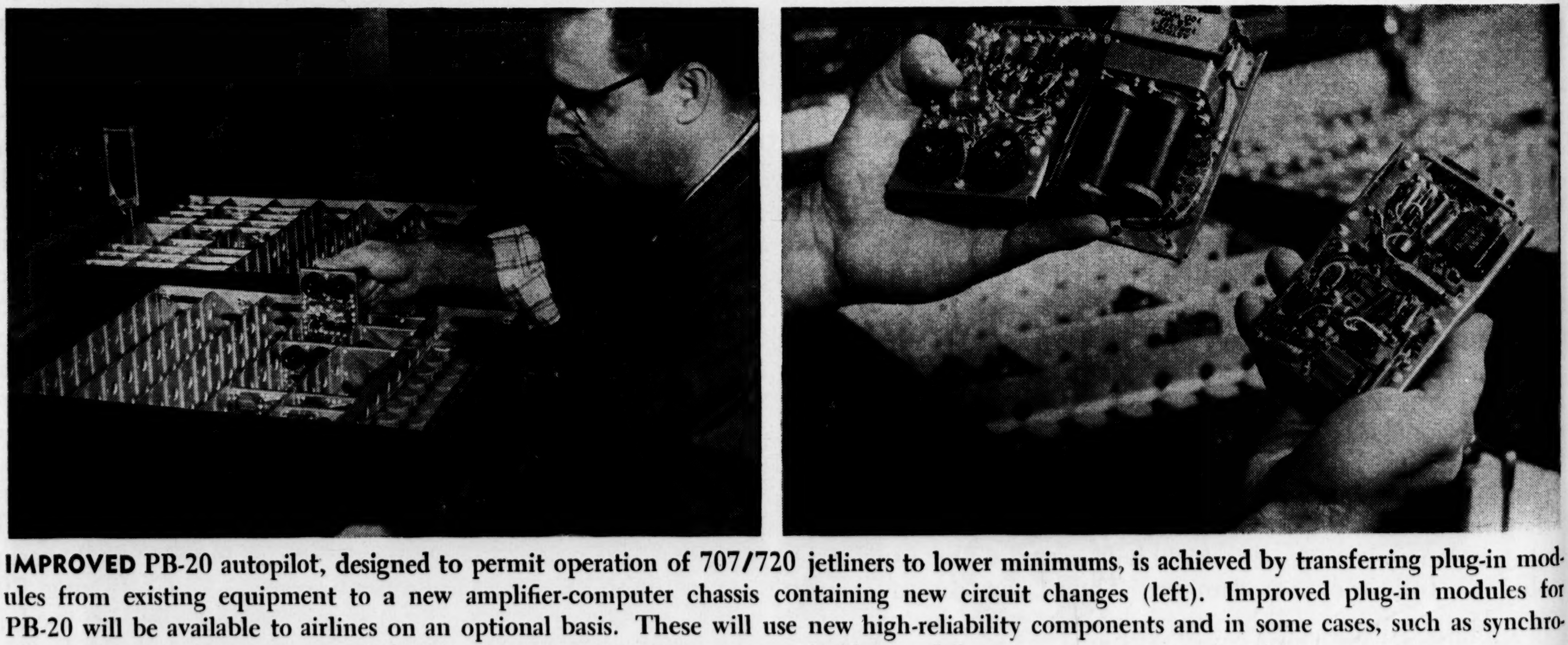
Bendix program is being carried out in three steps:

- **Phase I:** autopilot modifications intended primarily to improve performance, particularly during coupled approaches. These will appear in new PB-20 autopilots coming off Eclipse-Pioneer production line starting January.
- **Phase II:** design changes intended principally to improve equipment reliability and maintainability. These are scheduled for flight test in July and for introduction into new autopilots delivered after January, 1963.
- **Phase III:** a longer-range program to investigate, and implement where desirable, such new features as control stick steering, split-axis operation, automatic flare-out and also automatic airspeed control.

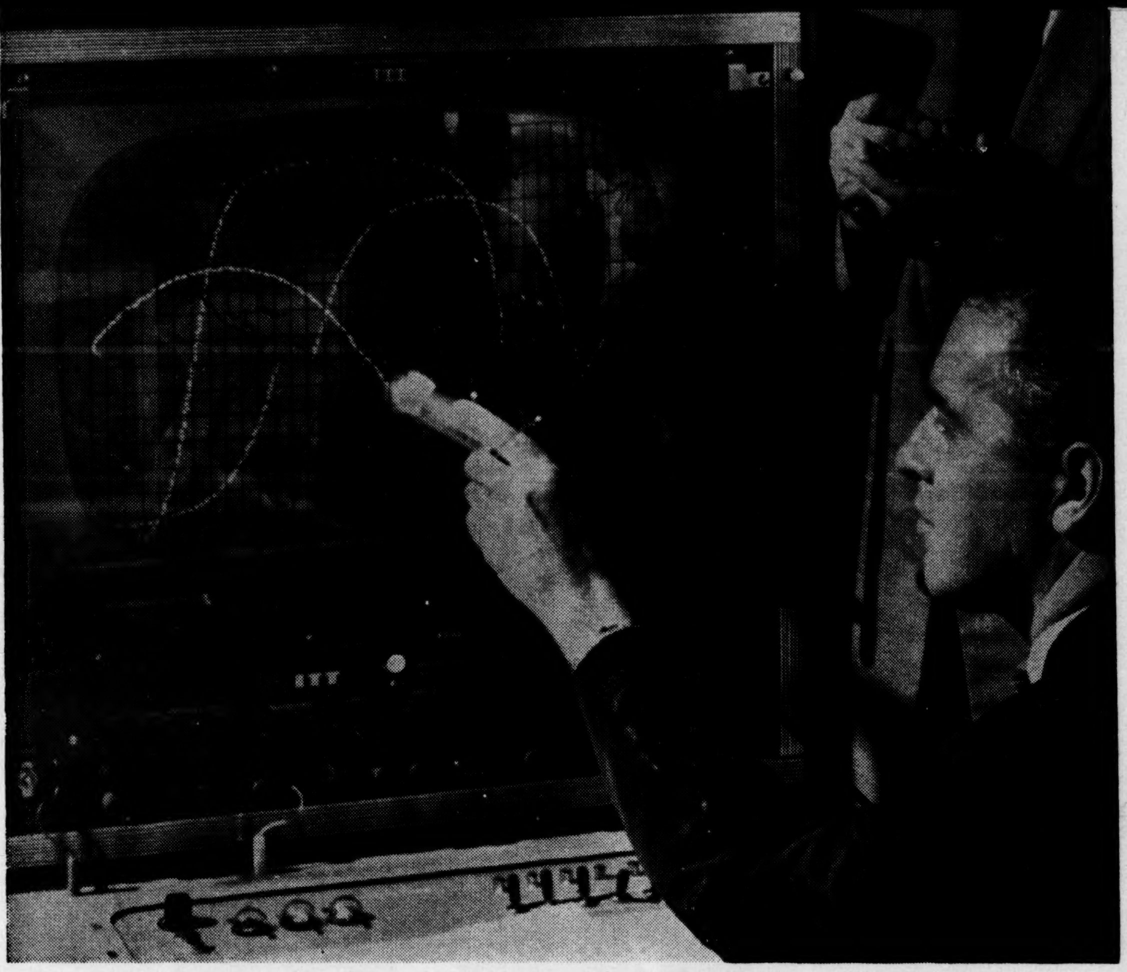
Airlines operating 707/720 jetliners will be able to update their existing PB-20 autopilots to incorporate Phase I and Phase II changes, and later Phase III additions. This can be accomplished either by purchasing a new PB-20 amplifier-computer chassis containing required circuit changes, to which existing airline plug-in modules can be transferred, or the circuit changes can be accomplished in existing chassis by airline personnel.

At the time of the January, 1962, factory changeover, Eclipse-Pioneer also will introduce a new series of plug-in units.

Functionally, these units will be identical to present modules to maintain interchangeability. But they will incorporate the latest types of high-reliability components, such as new transistor types and new solid tantalytic capacitors, according to W. H. Schofield, chief engineer of E-P's flight con-



**IMPROVED** PB-20 autopilot, designed to permit operation of 707/720 jetliners to lower minimums, is achieved by transferring plug-in modules from existing equipment to a new amplifier-computer chassis containing new circuit changes (left). Improved plug-in modules for PB-20 will be available to airlines on an optional basis. These will use new high-reliability components and in some cases, such as synchronizer shown at right, a single unit will perform same function as two of older modules.



## Satellite Track Display

**Satellite track display which shows orbits of up to six satellites superimposed on a mercator projection of the earth, can also show instantaneous position of satellite by brightened blip when operator points light gun at orbit.. Display, developed by Pastoriza Electronics Co., Boston, is undergoing final test at Air Force Spacetrack R&D Facility, L. G. Hanscom Field.**

trol laboratory. In some instances the new modules will be smaller and lighter.

The company refers to the PB-20 improvement program as TALL, an acronym for "Take Another Long Look."

Number of the improvements in the TALL program are the result of intensive programs launched within the past two years by several major airlines to track down shortcomings of present autopilots and flight directors to improve the adverse-weather capabilities of their aircraft, particularly the jetliners.

Early in 1959, Pan American World Airways, first of the U. S. airlines to launch its adverse-weather program, set out to debug its autopilot and flight director equipment and to familiarize its flight crews with their operation (AW May 15, p. 91).

By January of this year, PanAm began to encourage its line pilots to use autopilots, approach couplers and flight directors whenever possible, and to make a written report on their performance after each such flight.

Training procedures were altered to require crews to make an under-the-hood approach to 100 ft. in jetliners using flight directors during proficiency flight checks, and a similar requirement will be added for coupled approaches when additional improvements are made in the approach couplers.

Pilot reports are analyzed by engineers from Bendix and Sperry (whose SP-30 autopilot is used on PanAm's DC-8s), as well as by the airline's engineers and maintenance personnel to pinpoint areas that need improvement and change.

At recent Radio Technical Commission for Aeronautics meeting in Washington, Ben F. McLeod, who spearheads the PanAm program, said he considers the Bendix TALL program "outstanding" and said he expects that pilot reports will reflect the improvements. McLeod said PanAm has formed a group to work with Sperry on a similar production improvement program for its SP-30.

Here are some of the performance improvements which will be introduced into new PB-20s starting in January, and which airlines can incorporate into existing equipment:

- **Full-time command modifier:** In present PB-20 design, pilot must turn cockpit console selector switch to "manual mode" before putting aircraft on a new magnetic heading or a different VOR radial. Failure to do so before turning the heading knob on the course deviation indicator can introduce a sharp roll maneuver. The new circuitry eliminates the need for pilot to remember to return to manual mode and limits the maximum roll rate under such command conditions to four degrees per second. The modification also makes the autopilot better suited to radar vectoring used in high-density terminal areas by permitting engagement of the localizer beam capture mode while airplane is in a bank. This eliminates an extra pilot maneuver and reduces beam capture time.
- **Smoother VOR station passage:** When aircraft is coupled to a VOR station beam, the guidance signal becomes erratic as the airplane approaches and passes over the station—an area known as the "zone of confusion." In original PB-20 design, when the airplane enters the zone of confusion, the autopilot decoupled completely and the aircraft was flown on a constant magnetic heading until it passed the station. In the new configuration, the VOR signal is retained for guidance but is averaged out (by an integrator) to obtain a less erratic signal. This is expected to provide smoother passage over the zone of confusion and eliminate problem of recapturing the VOR beam when airplane emerges. Performance is expected to be independent of airplane altitude, airspeed and station cone width, according to Edward Zabransky, PB-20 project engineer for the 707/720.
- **Cross-wind compensation:** New circuitry and change in cut-in point of the lateral axis integrator is expected to reduce by half the time formerly required for autopilot to compensate for cross-wind when flying a VOR or localizer beam.

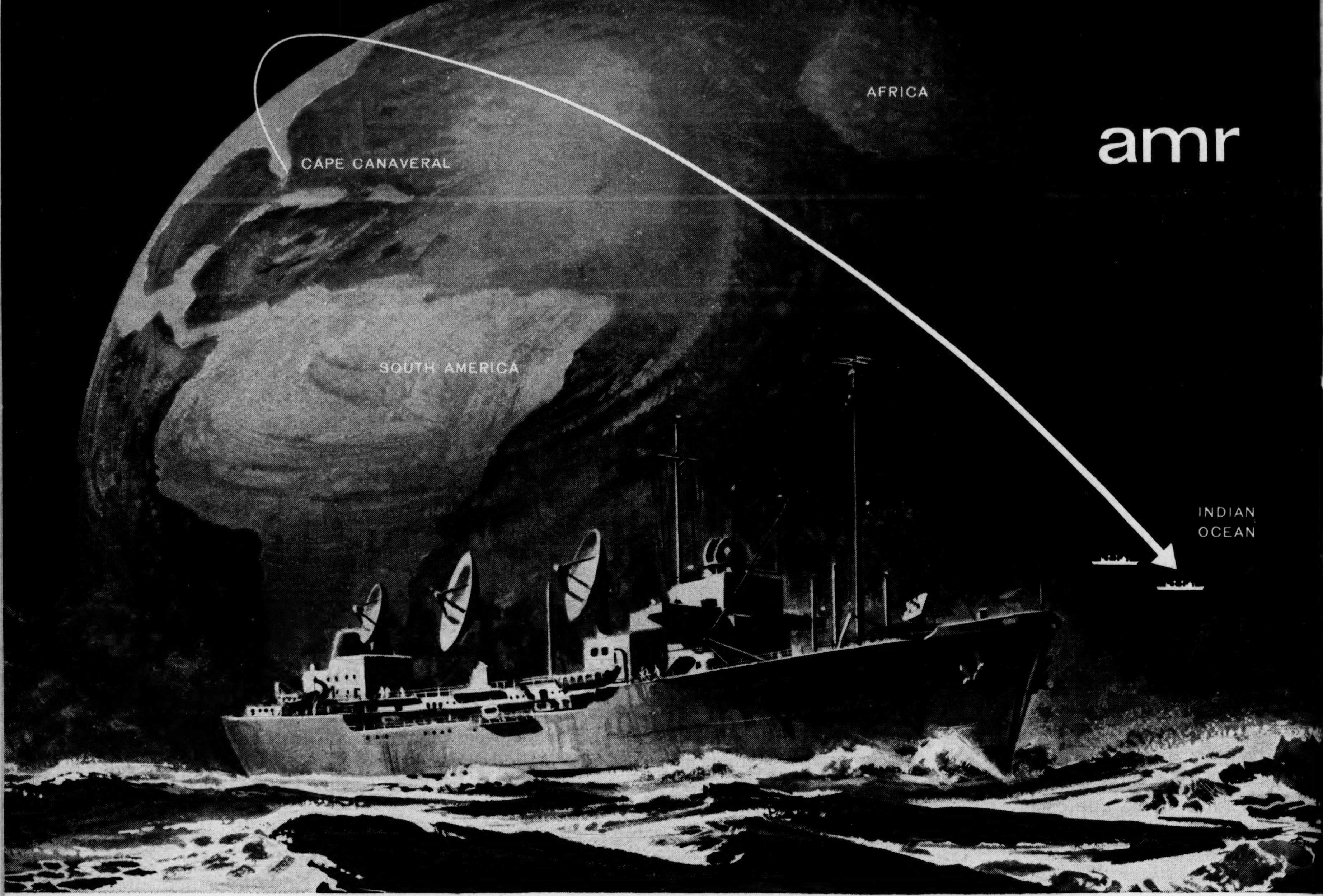
Modifications planned for Phase II of the TALL program are intended largely to improve reliability and maintainability of the approach coupler section of the amplifier-computer, but will not be limited to this function.

For example, a closer-tolerance integrator for pitch axis will be introduced to eliminate aircraft oscillations while proceeding down the glide slope. Another change is intended to achieve tighter constant-altitude control under low airspeed conditions. Many of the changes are intended to make autopilot-coupler performance more independent of variations in tolerance of circuit elements, including variations due to aging of components.

Other changes will take place in construction and fabrication techniques. For example, Bendix will change from soldered connections to connector pins with crimped connections. In the horizon (vertical) gyro, company plans to replace one of two single-row bearings used on each axis with a double-row bearing. This is expected to eliminate need for precise setting of reverse end play, cutting assembly time and cost and reducing gyro drift.

Eclipse-Pioneer is investigating, and in some cases already flight testing, a number of possible new additions to the PB-20 under Phase III of its TALL program. These include:

- **Variable beam capture angle:** When PB-20 approach coupler originally was engineered, it was designed to require the pilot to intercept a VOR or localizer beam at an angle of approximately 45 deg.—the standard instrument approach procedure of several years ago. With the advent of jets, the increase in traffic density in terminal areas and the use



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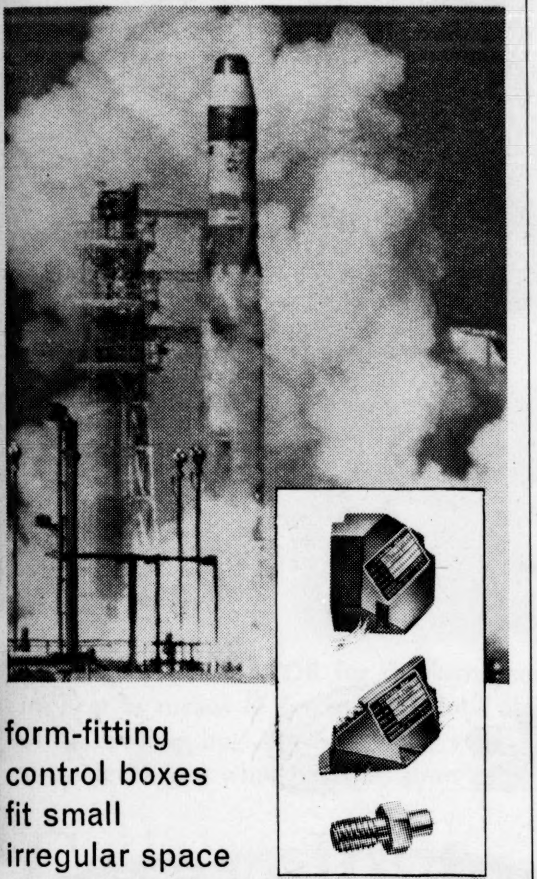
SPERRY

Solution to critical temperature control problem on TITAN guidance platform



form-fitting control boxes fit small irregular space . . . temperature held to within a few hundredths of one degree

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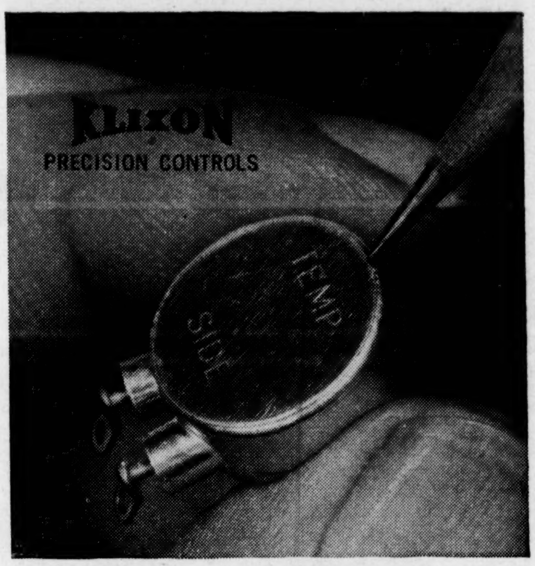
of radar vectoring, it now appears desirable to give the pilot wider choice in beam interception. Current investigations are aimed at providing such flexibility.

- **Split axis operation:** Both Boeing and Eclipse-Pioneer are evaluating merit of single-axis coupled approaches in which the other axis is flown manually. The Air Force is conducting similar investigations using a KC-135 and flight simulators.
- **Augmented glide slope:** Technique involving use of a barometric altimeter and simple analog computer to synthesize a stable glide slope angle, which in combination with the instrument landing system glide slope beam could provide more accurate guidance than the ILS beam alone, is also under flight evaluation.
- **Automatic flare computer:** Both Boeing and Eclipse-Pioneer are flight testing a variety of different automatic flare-out computer concepts. Currently, E-P is testing an exponential flare-out computer which uses a radar altimeter for height reference. Company B-25 also has participated in Federal Aviation Agency tests of Gilfillan REGAL system, and with AIL Division of Cutler-Hammer in evaluating its new Flarescan Instrument Landing System (AW July 17, p. 69).
- **Control wheel steering:** There is growing opinion that the present cockpit autopilot console with its small knobs is not the most convenient means for a jetliner pilot to introduce maneuvers via the autopilot. For this reason, Eclipse-Pioneer (and other autopilot manufacturers) are evaluating control wheel steering—a technique by which the pilot could use his regular control wheel to maneuver through the autopilot. This not only is a more natural means of control for the pilot, but also assures that he can take over instantly in event of autopilot malfunction. Eclipse-Pioneer currently is investigating the relative merits of rate versus displacement type control wheel steering.
- **Automatic speed control:** Automatic control of throttles, first attempted on a limited scale in the early postwar autopilots with mixed success, is once again under scrutiny as a possible assist in obtaining lower adverse-weather minimums. Boeing and E-P are jointly studying the feasibility of adding such automatic speed control to the 707/720 and the PB-20 autopilot.

Insofar as possible, Eclipse-Pioneer hopes to include necessary provisions for subsequent addition of Phase III features in the PB-20 amplifier-computer when the Phase II design is completed.

This would permit their later addition with little or no additional modification of the amplifier-computer.



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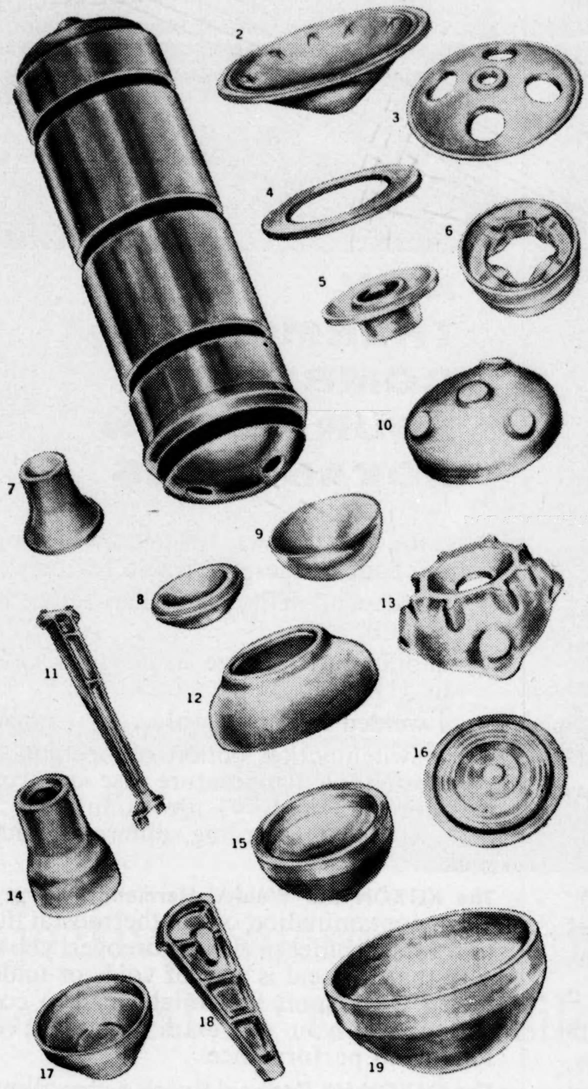

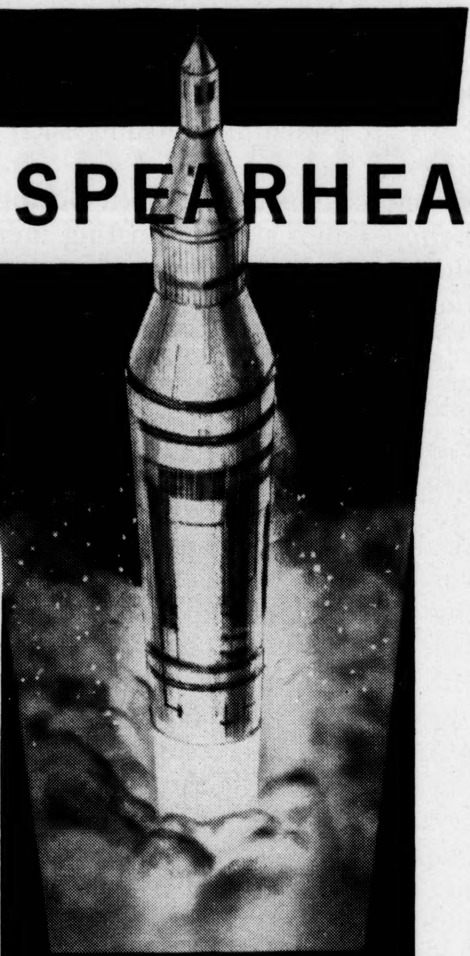

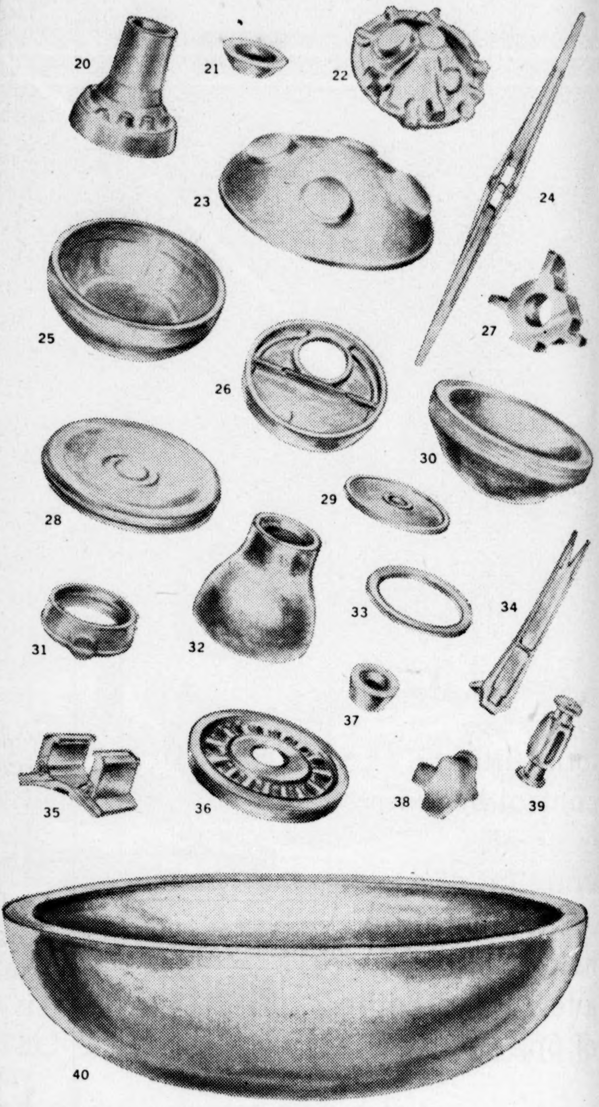

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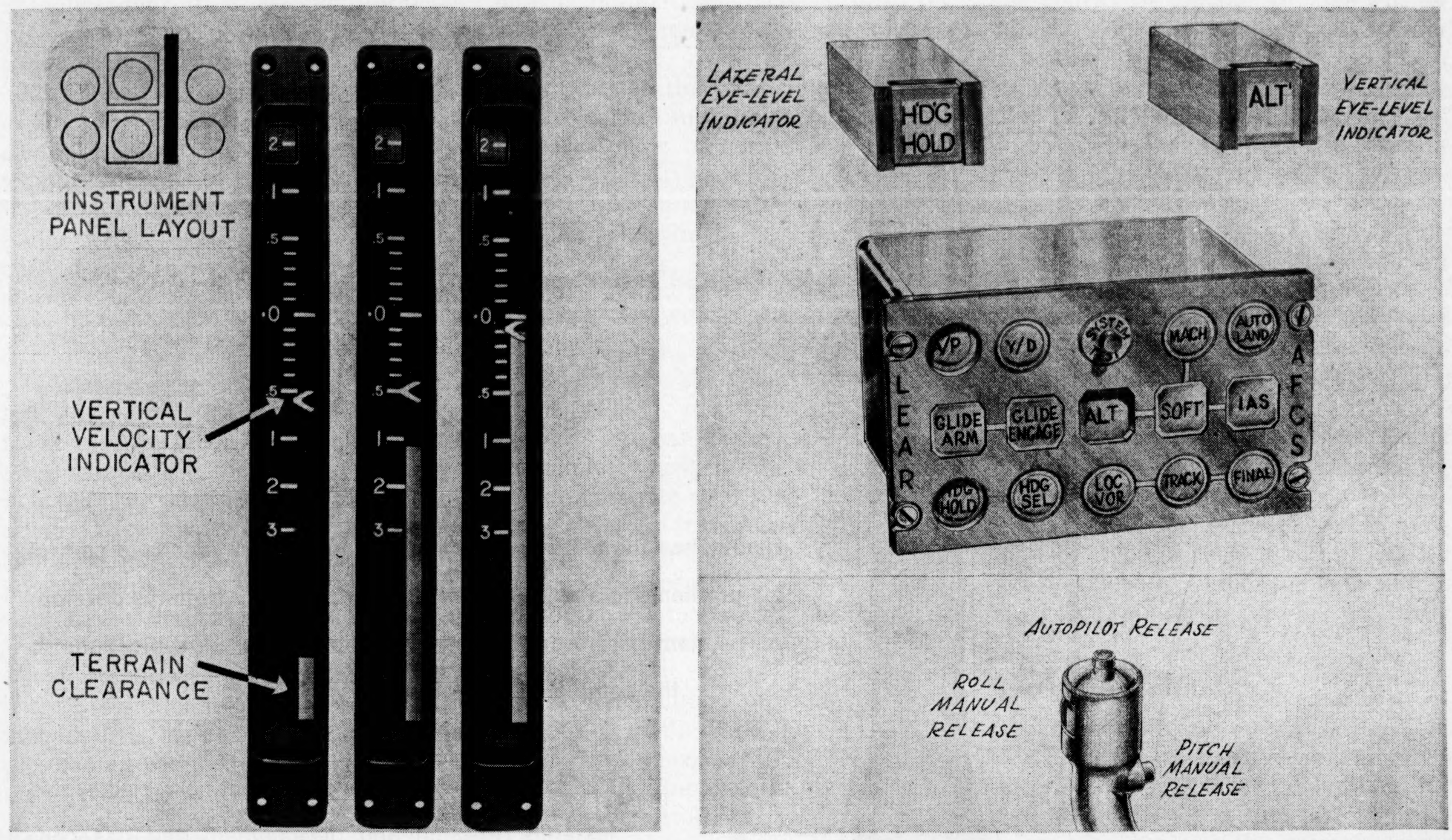


**VERTICAL INDICATOR** for displaying aircraft's vertical velocity and absolute altitude is one of the instruments which will be evaluated by Lear as means of improving pilot's ability to monitor an adverse weather landing. Moving tape shows aircraft clearance above ground while moving bug shows vertical velocity. A joint Lear-Air France program also will evaluate two small indicators (right), mounted at eye-level near windshield, to show pilot precise operating mode of each axis of autopilot previously set into controller (below).

# Caravelle to Test Autopilot Modifications

**Washington**—New techniques in autopilot design will undergo flight test soon aboard a Caravelle as part of a joint Lear-Sud Aviation program to lower operating minimums and eventually achieve automatic landing.

Program is sponsored by the U. S. Federal Aviation Agency and the French Air Ministry. Details of the program were reported by Lear's Kenneth Kramer at the recent meeting of the Radio Technical Commission for Aeronautics (AW Nov. 6, p. 33).

First phase of the three-phase Lear-Sud program involves modification of an existing L-102 autopilot and coupler to enable the Caravelle to make coupled approaches down to an altitude of approximately 100 ft.

## Tighter Coupling

To achieve the tighter coupling of aircraft to localizer required for lower minimums, airplane will be "side-slipped" rather than turned whenever it deviates from localizer beam center. This new concept, expected to accelerate aircraft return to beam center, was first proposed by Siegfried Knemeyer of the Aeronautical Systems Division's Flight Control Laboratory in Dayton, Kramer said.

To achieve this new type control, the rudder axis of the autopilot will obtain its signal from the flight director into which the pilot has pre-set runway heading. The roll axis of the autopilot will be coupled to the localizer receiver, as at present. When the airplane deviates from the localizer, the autopilot will bank the airplane but the rudder will displace to keep airplane from turning, causing it to side-slip back toward the beam, Kramer said.

In addition to providing more precise localizer coupling, the technique maintains airplane heading aligned with the runway, eliminating the de-crab maneuver prior to touchdown in the presence of a crosswind.

One possible objection to the side-slip method of control is passenger discomfort. However, Kramer said that if bank angle is limited to between three and five degrees, the amount of side-slip is not objectionable. This conclusion is based on flight tests conducted by Lear in a B-26. The Flight Control Laboratory also has tested the new technique in a C-131 (Convair) with excellent results, Knemeyer told Aviation Week.

Lear also had modified the L-102 to improve airplane coupling to the glide slope. Ideally, the gain of the autopilot should be decreased as the airplane approaches the runway because of the converging glide slope beam. In present autopilot coupler designs, the pitch axis coupler gain usually is set at a single median value. This makes the coupling too loose at the far end of the glide slope and unstable near the runway.

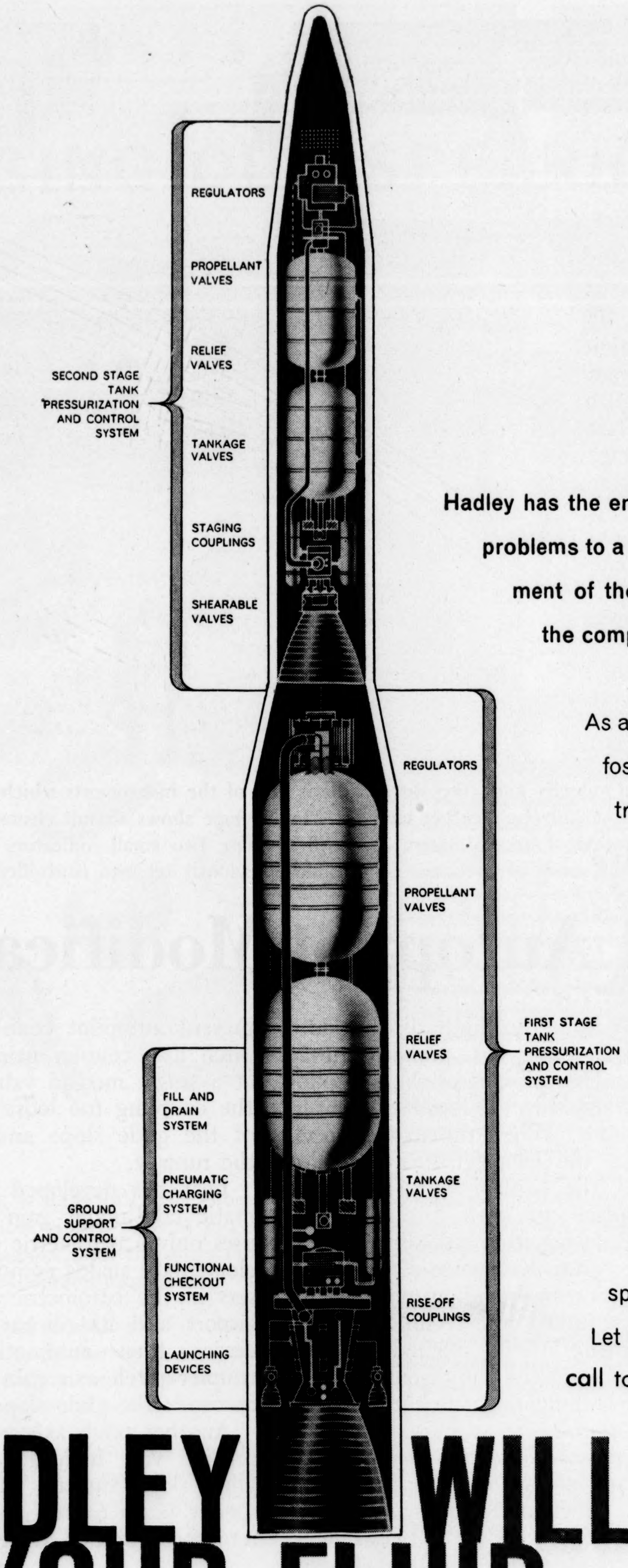
Lear has developed a simple automatic continuous gain changer which uses only a barometric element and an elementary analog computer. The pilot sets in the barometric pressure of the airport and its runway altitude. The device then automatically decreases coupler pitch axis gain as the aircraft descends the glide slope.

Another pitch axis modification will provide very high gain during initial glide slope capture mode, to assure speedy beam capture, after which gain returns to normal value.

## Automatic Flare Computer

Second phase of the Lear-Sud program, aimed at automatic landing, is already under way. The objective is to provide an automatic flare-out computer which will enable aircraft to consistently touch down within 250 ft. of the average touchdown point, Kramer said.

Lear's philosophy is that the computer used for automatic flareout should, if possible, be the same one used for glide slope control to give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assurance that it is working properly before airplane reaches flare-out altitude, Kramer said.

The question of whether a simple exponential (open-loop) type flare-out computer will prove adequate or whether the more complex recomputing (terminal guidance) type is required, is one which Lear hopes to answer in current tests in its B-26 and later tests aboard the Sud Aviation Caravelle. The recomputing type provides more precise control of touchdown point.

The heart of a simplified exponential type computer, now flying in the B-26, is an instantaneous vertical velocity sensor developed by Lear. This uses a barometric rate-of-descent sensor to obtain a steady-state reference signal and a vertical accelerometer whose output is integrated to provide an instantaneous vertical velocity signal.

By summing these two signals, a signal proportional to altitude rate-of-change is obtained which is completely independent of lags in the barometric sensors and the radar altimeter, Kramer said.

## Rate-of-Descent Signal

This rate-of-descent signal is used to control the pitch axis of the autopilot both during glide slope approach and during flare-out. At the instant of initial engagement with the glide slope beam, a rate-of-descent signal representative of that found in typical glide slope approach is introduced into the pitch axis. If aircraft does not stay centered on the glide slope beam, this rate-of-descent commanded by the autopilot is automatically changed until the aircraft does remain centered on the glide slope.

In this way the glide slope beam signal serves as a monitor rather than the primary source of control for the airplane's pitch axis. This decouples the aircraft from undesirable bends in the glide slope beam.

## Command Changed

When aircraft reaches an altitude of 200 to 300 ft., as determined by the radar altimeter, the glide slope monitoring is gradually removed so that by the time airplane has reached 100 to 200 ft., the aircraft is continuing to descend at the average rate of descent of the glide slope prior to its removal. When aircraft reaches an altitude of about 50 ft., the rate-of-descent command is changed appropriately to provide an exponential or modified exponential flare to touchdown.

The technique provides effective smoothing of the glide slope beam, particularly at lower altitudes, and keeps the radar altimeter out of the direct pitch axis control loop, using it only to determine whether to start fading out the glide slope monitoring and when to initiate the flare.

Eventually, Lear plans to replace the simplified flare computer with one that employs recomputation for more precise control of touchdown, but will retain the rate-of-descent control. Kramer indicated.

Present schedule calls for installation of the automatic flare-out computer in the Sud Aviation Caravelle in the fall of 1962 for its evaluation program.

A third phase of the Lear-Sud program calls for evaluation of different flight reference and situation displays to enhance the ability of the human pilot to monitor adverse-weather coupled approaches and automatic landings. The British Smith Instrument Co. Paravisual directors similar to those under evaluation by Boeing, are expected to be tested.

Also, Lear will evaluate use of moving-tape type vertical indicator which was developed by the company under Air Force sponsorship, and is also being tested by Boeing.

## System Monitor

Current thinking at Lear is that if it proves necessary to have an automatic autopilot performance monitor, the best approach is to use two identical autopilots, each with its own servo actuators, operating simultaneously. If one of the two autopilots malfunctions, the other will act to compensate for unwanted control action. Additionally, failure of one of the two systems should

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Subminiature accelerometer for use in Mark 2 inertial guidance system in the A-3 (2,500-mi. range) Polaris fleet ballistic missile, will be produced by Sperry Gyroscope under Navy contract. The device was developed by Massachusetts Institute of Technology, Cambridge, Mass.

**PROBLEMATICAL RECREATIONS 94**

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*– Contributed*

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assure that at least one will be operational for use in a coupled approach if the need should arise. The dual autopilot approach requires only the added weight of the servo actuators compared with the single autopilot with automatic monitor approach. Kramer believes this is a small price to pay for the added features.

Lear has flown this dual-operating autopilot system concept in a high-performance jet aircraft "with very satisfactory results," Kramer said, and company is now fabricating prototype hardware for flight tests on another high-performance jet.

In addition to the program with Sud Aviation, Lear also has a project under way with Air France. Its objective is to permit an immediate lowering of present weather minimums on the Caravelle, equipped with the Lear L-102, to 100 ft. and one-half mile. The program seeks to achieve this objective with minimum modification of the existing autopilots.

Company-owned Learstar, based in Geneva, is being used to test autopilot improvements. Those features which Air France finds desirable will be fabricated and flight tested then on a Caravelle.

In addition to changes intended to improve glide slope capture and provide smoother capture and tighter tracking of the VOR and localizer beams, Lear is evaluating the following new safety features:

- **Eye-level indicators,** mounted directly under cockpit windshield, to show pilot whether autopilot is engaged and in which mode it is operating.
- **Control wheel steering,** a simplified type, using switches, permits pilot to disconnect either or both autopilot axes for manual maneuvers of the airplane while autopilot continuously remains synchronized to the new airplane heading/attitude and is ready for instant take-over when wheel switch is released.
- **Minimum altitude hold,** which will prevent aircraft from inadvertently descending below 100 ft. altitude while making a coupled approach. Using signal from an existing radar altimeter, the autopilot automatically will level out and hold approximately 100 ft. altitude if pilot is engrossed in making visual contact and forgets to disengage the autopilot.
- **Automatic throttle control,** a simplified system for controlling throttle position to maintain constant airspeed, has been flight tested on the Learstar and a prototype system is scheduled for Caravelle tests early next year.

Second phase of the program for Air France calls for incorporating the automatic landing computer currently being developed as part of the Lear-Sud Aviation program.

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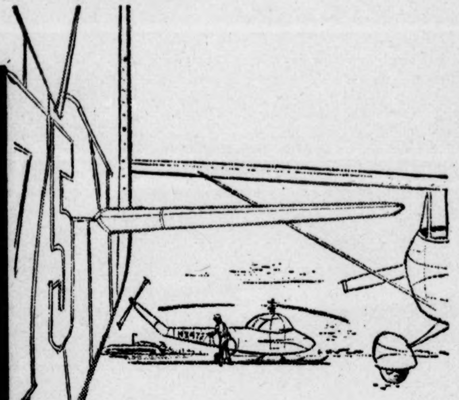

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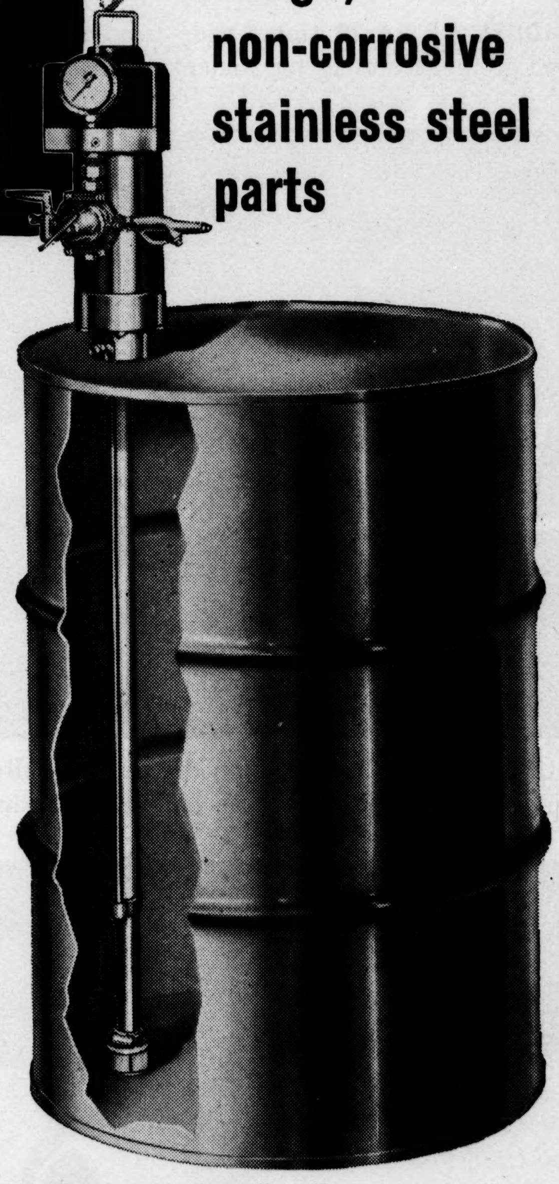

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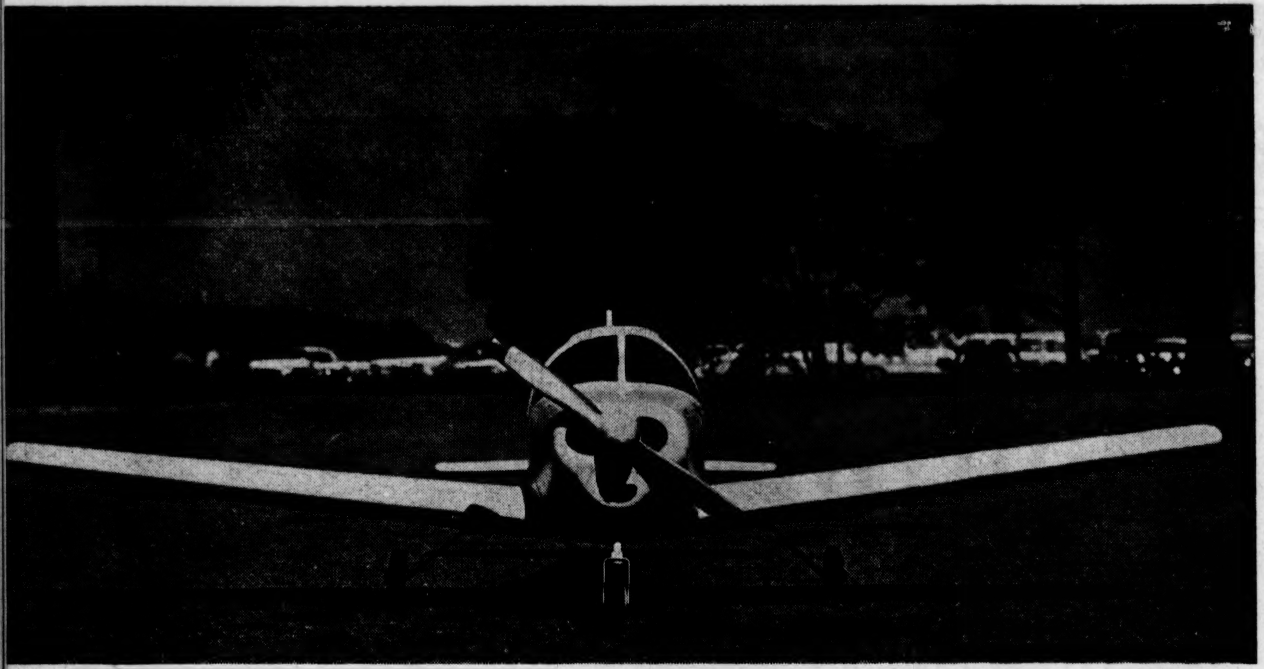
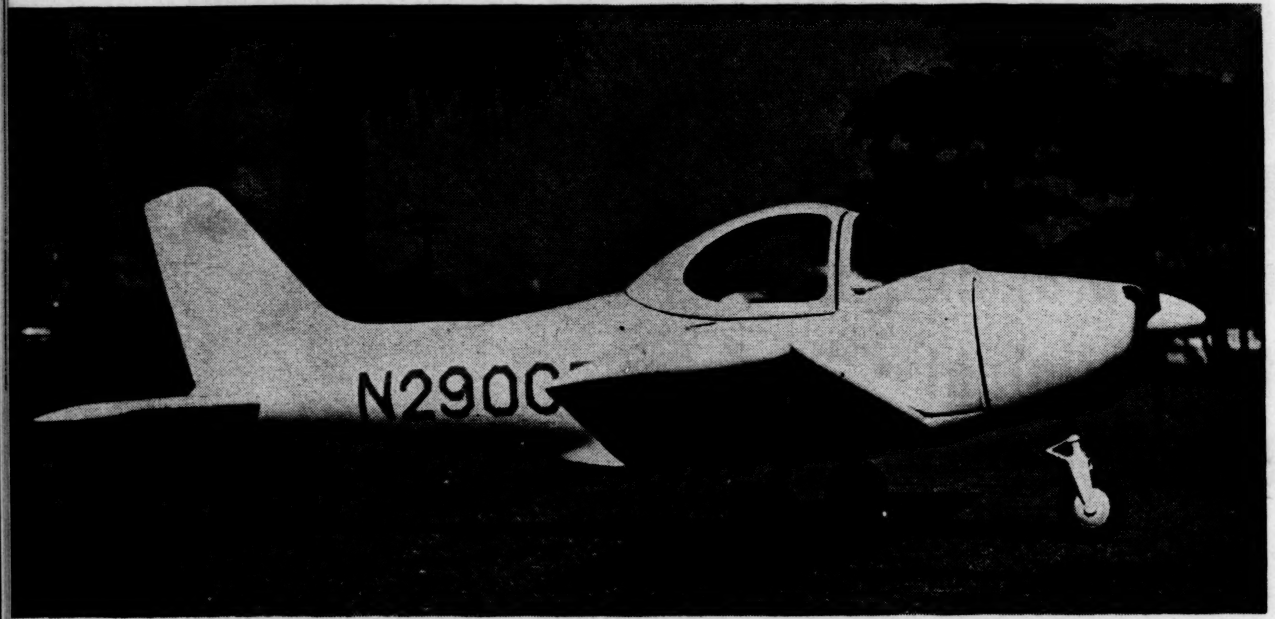
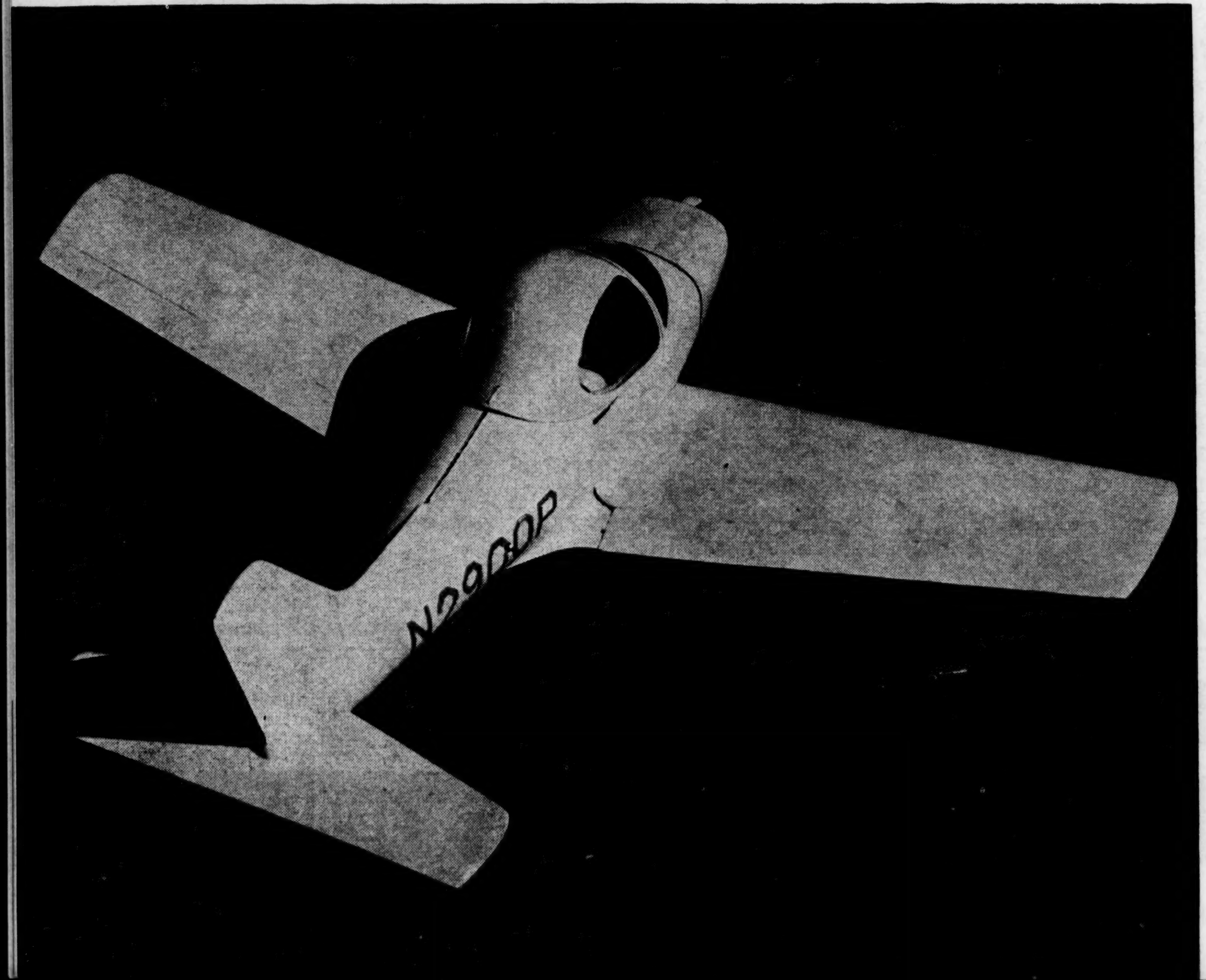


**MODEL OF PA-29** shows wide tread main gear which was adopted to simplify landing and ground handling for students and business pilots. Dihedral will aid stability.



**BUBBLE-TYPE CANOPY** provides ample headroom, good visibility and eliminates structural cutout needed for door. Slab tail, below, is similar to Comanche and Cherokee.



# Plastic PA-2

### By Erwin J. Bulban

**Vero Beach, Fla.**—All-plastic Piper PA-29 Papoose two-place "compact" lightplane, due to start flight tests here early in 1963, represents a full-scale research program aimed at materials, engineering and production breakthroughs that may markedly influence the company's entire line of business and utility aircraft in future years.

(Piper is considering dropping the name "Papoose" for the PA-29 project. The name, which has been with the project almost since its inception, is considered undignified by some company officials.)

Primary goal of the Papoose project now is to thoroughly research an all-plastic structure for this class of airplane in an attempt to achieve the major price reduction it promises. Management feels this reduction is necessary if Piper is to achieve its aim of bringing flying to a truly mass audience. (AW Nov. 20, p. 34).

The project has committed the company to a sizable expenditure already; development work started some three-and-a-half years ago and now encompasses a considerable portion of Piper's resources here. Piper management maintains that it is as yet purely research and, because of the radical approach it represents, they want to see for themselves how the airplane performs under actual operating conditions before any commitments are made for production. The Papoose project represents a major breakaway from Piper's past research and development programing. Formerly oriented toward development-engineering in previous designs, Piper is now placing major emphasis on research in this particular program because of its sharp divergence from conventional materials, processes and engineering requirements.

**TRAILING EDGE** of center wing section shows curves possible with plastic molding.

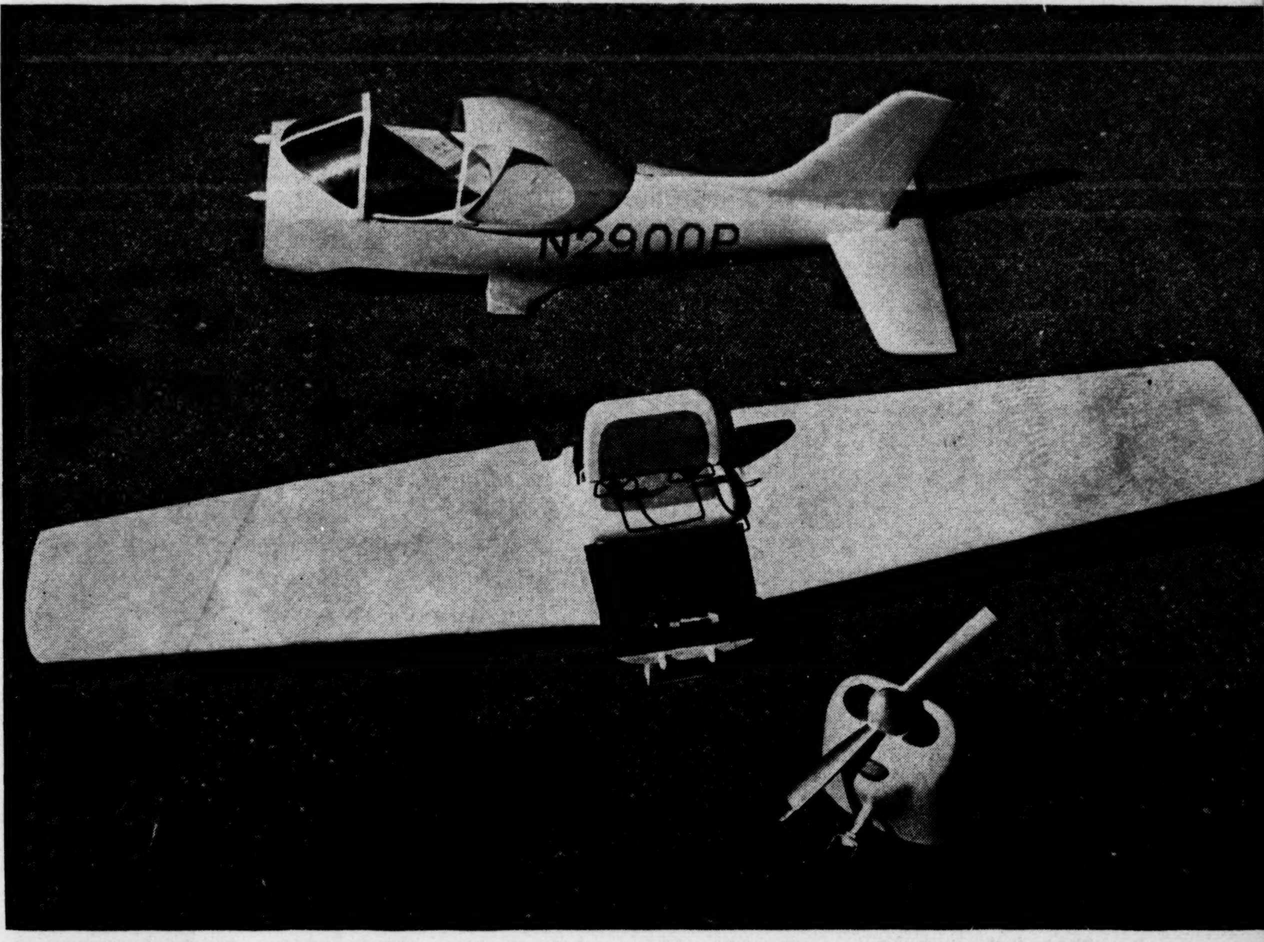
# Project May Benefit Entire Piper Line

Engineering and plastic production technicians are somewhat more optimistic because of the success they say has been achieved thus far in developing the structure and processing techniques, although they admit the final measure of the product will be in the flying. They expressed little doubt that the program could be applied just as well to the company's entire line of aircraft. One high-ranking member of the staff here told Aviation Week he saw no reason why it couldn't be applied as effectively to aircraft the size of a DC-3. Indications are that component testing thus far has resulted in studies being made on how reinforced plastics could be applied to current aircraft in the future. One instance mentioned was consideration of fitting flexing-type cantilever main gear struts to the Piper all-metal Cherokee.

How quickly this feedback is experienced in the other airplanes in the line probably will be determined after the Papoose completes its strenuous flight test programs, and also by how soon large investments in conventional tooling can be amortized.

The entire program is geared to developing an airplane that can be marketed at a substantially lower price than the current steel tube and fabric two-place Colt, which in the standard version lists for $4,995. How much less the Papoose will cost is something management declines to discuss, beyond saying that if the all-plastic Papoose can't do a better job at less cost than the Colt they wouldn't bother with it.

The basic Papoose experimental configuration currently measures 25 ft. in span, is 20 ft. 8 in. long and has a maximum height of 7 ft. Wing area totals 110 sq. ft. In comparison, the Colt has a span of 30 ft., a length of 20 ft. and a height of 6.25 ft. and the wing area totals 147 sq. ft.



**MAJOR PLASTIC ASSEMBLIES** will closely resemble this disassembled model. Wing will have seats, controls and instruments installed before it is mated to fuselage.

The Papoose is designed around the Colt's basic powerplant, a 108-hp. Lycoming O-235-C1B. But the Papoose is expected, after development, to be lighter than the Colt's 1,650-lb. normal gross weight. Because of this and its considerably aerodynamically cleaner design, it is expected to show important gains in performance. What the final Papoose configuration will weigh is hard to determine now, Aviation Week was told, because the prototype airplane will represent a beefed-up structure that will be refined as the test program proves it out.

The entire structure is of honeycomb sandwich material. Layers of $\frac{1}{32}$-in. glass fiber cloth form the top and bottom skins covering approximately $\frac{3}{8}$-in. thick Kraft 18-mill paper honeycomb. Honeycomb-patterned paper is supplied by Douglas Aircraft Co. in sheets 18-in. wide and 10-12 ft. long.

## Fabrication Process

Components are fabricated in high-temperature epoxy plastic molds designed and built by Piper's Plastics Division here. The company is reluctant to discuss exact details of the process, since they say that this is the key to maintaining low-cost output. But it is known that initial techniques formed the skins separately in individual molds, then transported them to another mold where they were plastic-bonded to the honeycomb paper. However, this process was abandoned be-

**LEADING EDGE OF CENTER WING** section shows how it is molded to fit flush with airplane's belly. "Separator" in wing is not spar, but will take up shear loads. Landing gear, at right, is all-plastic. Box in wing will absorb landing shocks.

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cause it was too time-consuming and costly and the current system developed here is a "one-shot" process.

It involves placing a plastic-impregnated skin in the mold, positioning the honeycomb paper and then completing the sandwich with the top layer of cloth. This is then covered with vacuum bags to maintain the pressure necessary to hold the three together during the heating process, which involves temperatures of 200F for two hours.

The exact technique of saturating the glass fiber cloth skins is also a subject which is discussed little with outsiders. This technique required considerable development to prevent the plastic from draining out of the cloth while the cloth is laying on the honeycomb and puddling in the sandwich.

Production engineering is slanted toward an optimum plastic structure made of a minimum number of components. As a result, the fuselage is built in two halves, split vertically with fin integral to this structure. The wing also is made in two halves, comprising top and bottom surfaces. The wing contains no ribs, stringers or spars—the only additional structures are the spanwise "separator," designed to keep the surfaces apart and reduce shear loads, and plastic-honeycomb boxes which take up loads from the cantilever plastic honeycomb main landing gear struts. Wingtips also are separate plastic structures, and are made detachable to permit inspection of the wing interior. To give some measure of reduction in components possible with plastic construction, the Papoose wing comprises a total of 35 parts, including all hardware, Plastics Division Manager Robert Drake told Aviation Week, and the entire airframe assembly will probably comprise just over 100 parts.

Actual assembly, once the wing, fuselage and other components have been completed, will further be simplified since cockpit components, such as seats, instrument panel and controls, will be installed on the completed wing prior to mating it to the fuselage.

Maintenance cost of the airplane is expected to be extremely low. Engineers believe it will be possible to incorporate coloring in the polyester resin plastic so that "paint" schemes will be integral with the structure, although exterior painting will also be possible.

Structure is naturally corrosion-proof due to its plastic makeup and also waterproof, since even the paper honeycomb is resin saturated.

Repairs to the structure will require a minimum of skills, they add.

They feel that the plastic structure is superior in fatigue life to a similar conventional metal structure. Tests on a full-scale experimental Papoose wing have included static loading that achieved 210% of design loading—considerably above Federal Aviation Agency's normal requirement of 165%—and failure was only experienced because a test fixture failed and pierced the wing. Drake pointed out that in cold temperature tests, the material has shown improvement in all physical characteristics during trails which subjected it to —32F.

## Piper Sales Forecast

**West Palm Beach, Fla.—Retail sales volume of approximately $60 million is expected by Piper Aircraft Corp. for 1962, according to J. W. Miller, sales manager.**

**This is similar to the sales target set by the company for 1961, which actually resulted in sales of some $40 million due to a sharp decrease in business resulting from the U. S. business recession early last year.**

**Miller is optimistic that Piper will come closer to next year's target, largely because field inventories are at a reasonable level. He told Aviation Week that company distributors and dealers had reduced field inventories of one- and two-year-old aircraft by about $6 million in the past 15 months.**

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Harnessing nuclear power for propulsion of large space vehicles is one of the many advanced programs now underway at the John Jay Hopkins Laboratory of the General Atomic Division of General Dynamics in San Diego, California. This and other advanced programs have created career opportunities in the following areas:

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All qualified applicants will receive consideration for employment without regard to race, creed, color, or national origin.

COLUMBUS DIVISION
NORTH AMERICAN AVIATION

# WHO'S WHERE

(*Continued from page 19*)

## Honors and Elections

**William J. O'Sullivan, Jr.**, of the Langley Research Center, has received a $5,000 National Aeronautics and Space Administration award for his invention of the inflatable space vehicle concept which led to the Echo passive communications satellite. The award was the largest made under Space Act authority to give cash awards for inventions.

## Changes

**Dr. Neal M. Burns**, director, Advanced Life Sciences Division, The Decker Corp., Bala-Cynwyd, Pa.

**Richard A. Gray**, production manager, Sperry Semiconductor Division of Sperry Rand Corp., Norwalk, Conn.

**H. W. Pochyla**, assistant to the manager of Lockheed Aircraft Service Special Devices Division, Ontario, Calif. **Victor Diatlovich** succeeds Mr. Pochlya as manager of the Lockheed Aircraft Service base operated for the FAA Bureau of Research and Development, Atlantic City, N. J.

**William E. Drees**, manager of manufacturing, Arnoux Electronics Division of Arnoux Corp., Los Angeles, Calif.

**Tadelusz J. Siek**, manager-market research and planning, Waltham Laboratories of Sylvania Electric Products, Inc., Waltham, Mass.

**Jack L. Zook**, international sales manager, and **John C. Maurer, Jr.**, controller, Cessna Aircraft Co.'s Marketing Division, Wichita.

**Hans Hogeman**, manager of engineering, American Bosch Division, American Bosch Arma Corp., Springfield, Mass.

**John B. Lawson**, director, Administration and Manufacturing Staff, Ford Motor Co.'s Aeronutronic Division, Newport Beach, Calif.

**S. J. Pipitone**, manager of the newly formed Space Systems Engineering Division of Goodyear Aircraft Corp., Akron, Ohio.

**Thomas J. Richert**, assistant to the vice president of engineering and maintenance, United Air Lines, Inc.

**Donald W. Chrisman**, director of planning, Martin Co.'s Electronic Systems and Products Division, Baltimore, Md.

**Julian Zuke, Jr.**, manager-technical liaison, Camloc Fastener Corp., Paramus, N. J.

General Electric Co.'s Defense Systems Department has appointed **William M. Jenkins** manager of European operations for the Information and Control Systems Product Section, responsible for the engineering integration and site implementation activities for the Air Weapons Control System 412L, with headquarters at Wiesbaden, Germany.

**Harold W. Barenz**, director of operations planning, American Airlines, Inc.

**Samuel B. Fishbein**, director of military programs, Capehart Corp., Richmond Hill, N. Y.

**George P. Townsend, Jr.**, chief of basic design, Hamilton Standard Division of United Aircraft Corp., Windsor Locks, Conn.

**Hamilton O. Hauck**, assistant general manager, Raytheon Co.'s Missile & Space Division, Santa Barbara (Calif.) Operations.

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# LETTERS

***Aviation Week welcomes the opinions of its readers on the issues raised in the magazine's editorial columns. Address letters to the Editor, Aviation Week, 330 W. 42nd St., New York 36, N. Y. Try to keep letters under 500 words and give a genuine identification. We will not print anonymous letters, but names of writers will be withheld on request.***

## Strategic vs. Tactical

I fail to see your "Dismal Pattern" (AW Nov. 6, p. 21), but I think I recognize another equally disturbing design. You infer that the Communists attacked in Korea because our government decided not to spend some money on weapons which Congress had appropriated. I would like to suggest that perhaps the true reason the Communists flex their muscles periodically is because Congress is pushing for an increase of strategic power (which clearly could not meet the situation in Korea and the other areas you mention) and neglecting the tactical requirements of warfare (wherein the Communists could be met on their own territory).

The Administration refuses to spend such strategically earmarked funds but does not demand funds for tactical weapons in their place. This unfortunately leaves the public with neither a long-range strategy nor a short-range tactic.

Lincoln A. Watkins
The Johns Hopkins University
Applied Physics Laboratory

## Spur to Progress

Re the letter "Airline Business," AW Nov. 13, p. 138.

The attitude of "don't criticize—they're doing their best" goes along with "let's not subject them to competition." I do not believe U.S. aviation would have reached its present advanced state without the criticism and competition to which it has been subjected. There is endless room for improvement and that applies to every phase of airline operation from ticket selling to maintenance.

If we are the victims of occasional fumbling we have every right to publicize these fumbles, and to expect improvement. The public expresses its appreciation by its patronage, and expects on-time departures and arrivals consistent with circumstances within the control of the airline. The public is also entitled to courtesy, information, and every cooperation in reaching a destination safely and comfortably, and the more this is done the more business you get and vice versa.

Airline administration is the first to ask the public to complain. I do pay tribute to high morale where it persists in the face of mounting deficits.

A. L. Rubenstein
New York, N. Y.

## Boost for Dyna-Soar

I am very disappointed that the United States is still making only a hesitant and half-hearted effort on the Dyna-Soar program when this project deserves, in fact, the highest possible priority. Dyna-Soar has a number of very useful applications as a weapons system: an optical surveillance platform invulnerable to ordinary anti-satellite defense measures because it is maneuverable; a carrier of nuclear weapons for bombardment of enemy countries; and a means to intercept and destroy Russian Dyna-Soar type craft.

If the Russians get the Dyna-Soar first and start flying nuclear weapons over our skies, a panic of unprecedented proportions will sweep the country. Khrushchev's hand at the conference table will be greatly strengthened. If, on the other hand, we get Dyna-Soar first, we can do the same thing and keep the Russians in line. Dyna-Soar is the next big advance after the ICBM. Disaster will follow if we are as negligent as we were with ICBMs 10 years ago. I hope that the Russians are not working on Dyna-Soar type craft; otherwise this country is facing more trouble than it ever knew existed.

I have read with interest the airlines' excess seat dilemma and am surprised that they have not taken the obvious measures to correct the problem. On routes which have excess seat problems they should simply reduce the number of daily flights until the planes are filled. While this would cause great passenger inconvenience in once-a-day routes, it could certainly be done on routes in which there are many flights per day. Even with the reduced number of flights there would be enough left for the passengers to find convenient schedules. The planes idled by this plan could be used for extra flights during holiday and other peak travel periods.

Frederick Pilcher
Lawrence, Kan.

## Transportation Policy

It is gratifying to see what may be the first step in establishing a federal transportation policy (Airline Observer, AW Oct. 30, p. 47), ". . . Department of Commerce national transportation policy report . . . need for airline user payments. . . .").

There is a vital place and need for each segment of our total transportation system, but no one segment should be taxed to support the others. It is time our legislators woke up to the need for sound business practices, or else kick in to the socialist-federal control planners once and for all. It is little wonder that the railroads find themselves in such a plight when they are taxed exorbitantly to provide funds to build airports and highways for competitors.

The common fallacy in regulatory agencies controlling the airlines has been the effort to make them competitive dollar for dollar with surface transportation when they provide premium transportation. It is like providing a Cadillac to one who can only afford a Volkswagen, the government making up the difference!

The airlines have exceeded the railroads in passenger miles traveled (except commuter service) for a number of years, yet their subsidies in one form or the other continue to grow rather than diminish. It is high time that subsidies be eliminated on a graduated scale with a definite target cutoff date not to exceed five years. This includes not only direct subsidies but also free airway navigation aids and facilities, safety facilities, aircraft development, airports, and the myriad of other free government services.

The "grand" comparison usually made to justify airline subsidy is the early land grants (1867). Only 8% of the railroads received these grants for building into the wilderness. In exchange for these grants the affected railroads agreed to provide certain services for the federal government at reduced rates. When this agreement was mutually abrogated in 1947, the government issued a report to the effect that it had received services three times over the land involved in the grants.

If the airlines are having difficulty to hold a favorable earning capacity in these times of prosperity, what will they do in times of extended leveling off? Much of their distress can be traced to "living beyond their means"—buying very expensive equipment, increasing load capacity without a corresponding increase in patronage, service to points that do not justify service. The time is ripe for the long overdue "weaning" of the airlines, and their hard appraisal of a self-sustaining rather than subsidy existence.

D. H. Gerbaz
La Mesa, Calif.

## Flexible Technology

The editorial staff and the board of directors of Aviation Week should be complimented daily for the open minded, clear headed thinking displayed in inviting reader comments in what has developed into the best aeronautical science magazine for the fascinating profession of aerology in this modern era.

Only by keeping the basic structures of planning flexible can there be progress. Otherwise a ponderously stationary condition would result.

Private aircraft manufactured for the use of the public in the division known as private aviation has managed to develop the above mentioned arrangement since World War II. Not one sleek, extremely well designed, highly refined plane on the market today is even spinable much less acrobatic. There is no finer confidence builder for the over cautious pilot than spins and acrobatics, particularly when the prices of these new aircraft are considered. The prices extend anywhere from $7,000 to over $100,000 new, and not one loop or snap roll designed in the entire assembly.

With modern advances in production, at least one model of four passenger, single engine and one model of multi-passenger, multi-engine aircraft really ought to be manufactured and available for purchase by the public that is both spinable and fully acrobatic.

Postwar static and planning trends have already left an effect upon American prestige and morale both here in the United States of America and in the countries abroad.

Dwight B. McLaine, Jr.
Chattanooga, Tenn.